AUTOMOTIVE and Aviation INDUSTRIES

MARCH 1, 1943

IN THIS ISSUE . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 88 March 1, 1943 Number 5

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

New Processes To Be Shown

It is expected that an entirely new process for assembling of aircraft structures will be revealed at the Machine and Tool Progress Exhibition being held in Milwaukee concurrently with the national meeting of the American Society of Tool Engineers this month. This process, it is understood, is neither welding nor brazing, but a combination of the two. It works through induction heating according to reports, and requires less skill than either conventional welding or riveting.

In the welding field also it is expected that a new welder for aluminum will be shown for the first time which operates neither from line current nor by the discharge of condensers. Reportedly it provides greater control over weld quality and higher speed welding with inexperienced help than available heretofore.

Designed to assist manufacturing organizations in current retooling problems, in facilitating the employment of women, in conservation of materials, etc., the exhibition is scheduled for three days, March 25 to 27.

COMPLETE ANALYSIS
OF PRODUCTION REQUIREMENTS

By CINCINNATI Service Engineers
Saves Time . . . Eliminates Long "Build Up"
to High Production Rate

● In this highly mechanized conflict, designs of war materiel change even more rapidly than the ever-changing pattern of peace-time goods. The armies who have the most practical designs obviously have the greatest advantage. Nevertheless, the advantage remains on paper until the material is *delivered* to our armed forces. They need it *quickly* to win quickly.

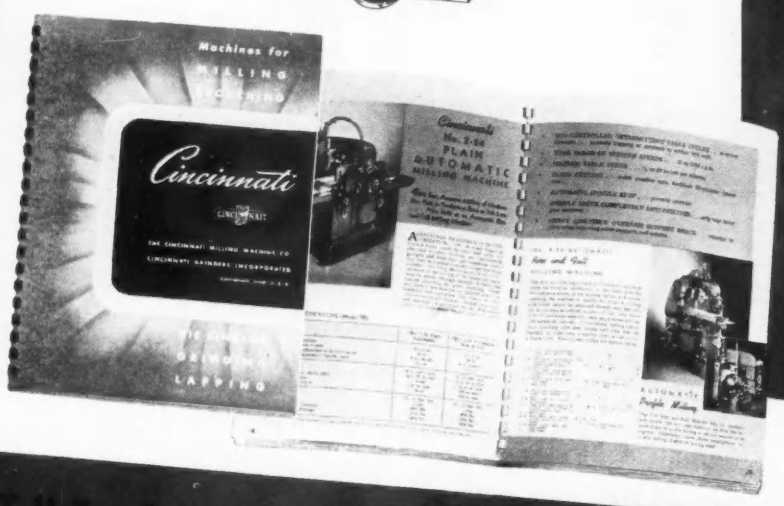
This is where CINCINNATI Service Engineers can help you. They have years of experience in working out methods of producing parts requiring machining operations in the fields of milling, grinding, broaching, lapping and cutter sharpening. The most modern data, substantiated by a staff of research engineers, is available for their estimates. They have a wide choice of machine tools for their recommendations, from a 4″ Plain Grinder to a 36″ Horizontal HydroTel Milling Machine with 120″ table travel. One of their typical analysis sheets is shown here . . . note that 24 of the operations are done on machines bearing the CINCINNATI trade mark.

Perhaps some of the parts in your own shop could be produced faster and on fewer machines. Send blue prints and sequence of operations to us, and our engineers will give you their recommendations.

CINCINNATI

PART NAME [redacted]
REQUIRED PRODUCTION - [redacted] PER HOUR

OPER.	NAME	PRODUCTION NOT COUNTING SET-UP	SKETCH	OUR ORDER NUMBER	MACHINE
1.	DRILL TWO 13/16 HOLES				X
2.	BURN OUT				X
3.	HEAT TREAT & BRINNELL				X
4.	RGH SLOT TO .845 TO 7.487 .851 TO 7.493	15½ PER MACHINE	PRINT E	41K-352559	THREE NO.2-24 AUTO. RAF
5.	STRADDLE MILL SIDES & BOTTOM	25	2 ABREAST	--	NO. 3-24 PL. AUTO
6.	BROACH 1 SIDE BETWEEN EARS TOP OF TRUNION & 1 SIDE OF EARS		B-1854-B	41B-343307	
7.	BROACH TOPS OF EARS		B-1854-A	41B-343307	
8.	BROACH OPPOSITE SIDE-SAME CUT		B-1854-C	41B-343307	
9.	STRADDLE BROACH EARS-1ST. CUT		B-1854-D	41B-343307	
10.	STRADDLE BROACH EARS-2ND. CUT	33 PER MACHINE	B-1854-D	41B-343307	TWO NO. 10-66 DUPLEX BROACH
11.	FORM BROACH ENDS 1ST CUT		B-1854-E	41B-343307	
12.	FORM BROACH ENDS 2ND CUT		B-1854-E	41B-343307	
13.	STRADDLE BROACH EARS 3RD CUT		B-1854-D	41B-343307	
14.	BROACH BETWEEN TRUNIONS & EARS		--------	41B-343307	
15.	BROACH 1ST. CUT BETWEEN EARS & TOP STEP 3 DEG. & 6 DEG. ANGLE 1 END.		B-1854-F	41B-343307	
16.	BROACH 2ND CUT BETWEEN EARS, LOWER STEP 3 DEG. & 6 DEG. ONE END, AND 3 DEG. ANGLE OPPOSITE END.		B-1854-G	41B-343307	
17.	DRILL FOUR .393 HOLES, ONE 7/16" HOLE AND HOLLOW MILL TRUNIONS				X
18.	PROFILE CONTOUR OF EARS				X
19.	MILL BEARING PADS	87	PRINT C	41M-345187	NO. 0-6 AUTO RAF
20.	MILL 75 DEG. & 7 DEG. ANG. CUT	52 PER MACH.	PRINT B	41M-344256	TWO NO. 2-18 AUTO RAF
21.	MILL .394 X .079 SLOT IN EARS	40 PER MACH.	PRINT D	41M-344257	TWO NO. 2-18 PLAIN AUTO.
22.	MILL .878 X .433 DIM.	52	RECIPROCATE	--------	NO. 1-18 PLAIN
23.	MILL .394 X .059 SLOT IN EA. SIDE	30 PER MACH.	PRINT A	41M-344256	TWO NO. 2-18 AUTO. RAF
24.	MILL 30 DEG. CUTS X .236 DIM.	40	RECIPROCATE	--------	NO. 0-6 AUTO RAF
25.	PROFILE .472 ELONGATED HOLE IN RIGHT END				X
26.	FINISH PROFILE 1.004 TO WITHIN .197 OF BOTTOM	15 PER MACH.	BOX MILL	41M-352559	TWO NO. 2-18 AUTO RAF
27.	PROFILE 1.496 AND .984 DIM.	31	BOX MILL	--------	NO. 2-24 AUTO RAF
28.	PROFILE .118 CUTS	40	BOX MILL	--------	NO. 2-24 AUTO RAF
29.	PROFILE 1.004 AT BOTTOM			--------	X
30.	DRILL .502 RAD. IN RIGHT END			--------	X
31.	REAM .492 RAD AND 1 DEG. 26' ANGLE				X
32.	FORM CUT RADIUS NEAR TRUNION				X
33.	POLISH EDGES ALL OVER				X
34.	FILE WHERE NECESSARY				X
35.	PARKERIZE				X
					TOTAL



Left: General Catalog, No. M-995-1. Contains illustrations and condensed information on complete line of CINCINNATI Milling, Grinding, Broaching, Lapping and Cutter Sharpening Machines

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, OHIO

TOOL ROOM AND MANUFACTURING MILLING MACHINES . . . SURFACE BROACHING MACHINES . . . CUTTER SHARPENING MACHINES

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March

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

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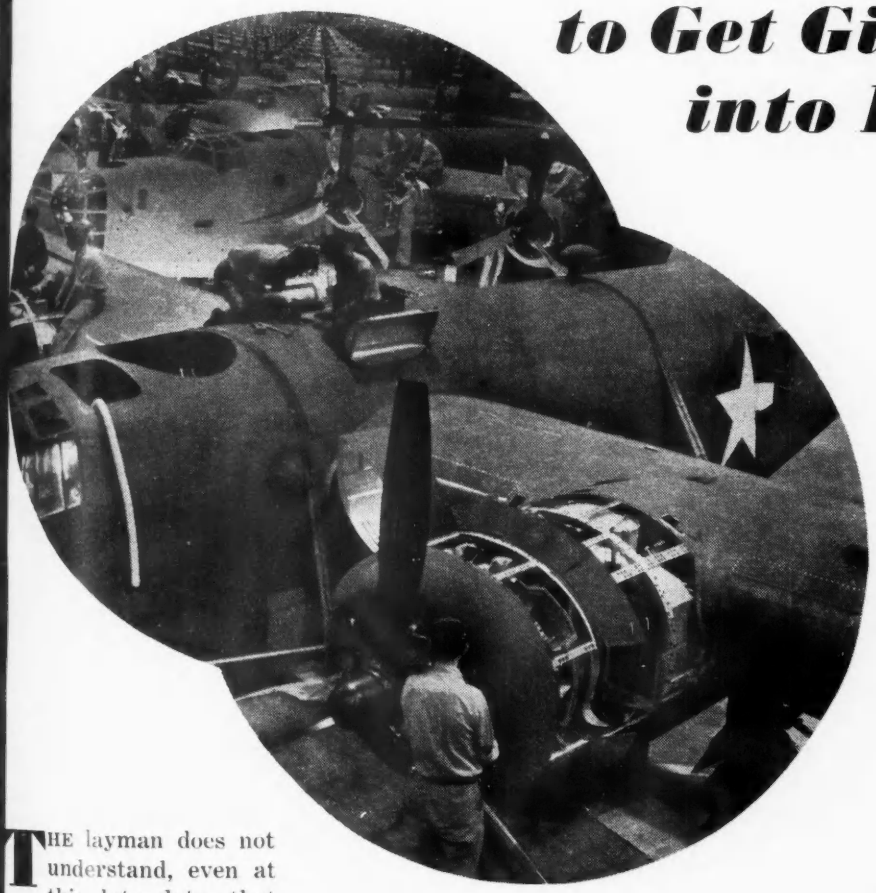
What It Takes

to Get Giant Planes into Production



THE layman does not understand, even at this late date, that building a large airplane capable of carrying heavy loads is a very complicated operation. In fact, prominent people outside the industry still think that all there is to building aircraft ranging from 50 to 150 tons is to say, "Do it!", and it is done.

It is surprising how quickly those who attempt such speedy, ambitious programs, revise their statements after either a careful investigation or actual invasion of the aircraft industry. In the middle of last year several manufacturers with wide experience in creating other products made startling statements about what could be done—and were quickly disillusioned.

By Harry Woodhead

President Consolidated Aircraft Corp.

I can recall with a blush that when I first started at Vultee I suffered from the same wild enthusiasm. I soon found that, to put it mildly, I was both uninformed and wildly optimistic. I've learned things, too.

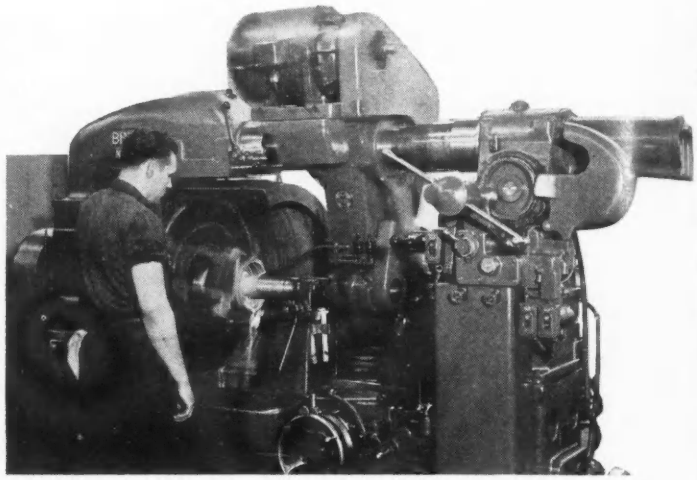
It is common knowledge that we have at present the mock-up of a 400-passenger airplane capable of a speed which we hope will be over 300 miles per hour. Frankly, although we have worked at a fast pace for many months, we have still a long way to go. I would estimate that a plane of this size will take two years from conception to birth—that is, from the time of the first design drawing until the experimental airplane actually flies, and another two years before quantities roll off the production line.

It took nine months for the experimental process with the Liberator. That established a new record for a plane of that type, and it was two years more before mass production was a reality. The Liberator weighs only 28 tons fully loaded, it was designed simply with a view to mass production, and it was partly an outgrowth of an earlier model, the 31, a flying boat which will go into

(*Turn to page* 50, *please*)

Borg-Warner *Rehabilitates* *Now Makes Oerlikon*

This is the Seventy-ninth in the series of monthly production features



Close-up of one of the Bryant internal grinders used in the NMP plant.

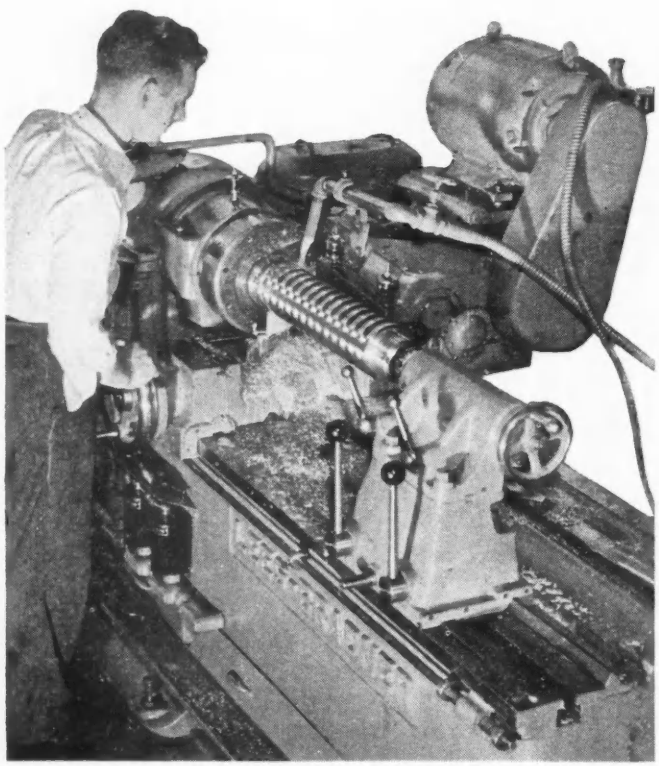
CREATED late in 1941, the Norge Machine Products Division, Borg-Warner Corp., now an important producer of gun mounts for the Navy's Oerlikon guns, marks an exemplary episode in the war effort. Although the organization started from scratch —without a home, without a working force, or equipment—it did have the overwhelming advantages of the resources of the parent company—in management skill and production know-how.

Within a short space of time, the new organization had acquired an old vacant plant in Muskegon which had had a record of accomplishment in World War I. The old mill-type buildings were completely rehabilitated—new roofs installed, windows replaced, new concrete floors laid, re-wired for power, cleaned up and painted. Good seeing was provided by an installation of modern fluorescent light sources.

Having acquired a plant without drawing upon critical building materials and precious time, the next major problem was that of procuring the production equipment suitable for the manufacture of gun mounts made to exacting Navy specifications. Fortunately the facilities of the Stover Mfg. and Engine Co., at one time an important factor in the industry of Freeport, Ill., were available. Here was found an inventory of about 545 machine tools—all old and in various stages of dis-repair. Only about 20 per cent of these machines were suitable for immediate use, the others had to be completely dismantled and rebuilt.

Moreover, all of the old equipment was line-shaft driven. For the new home, it was desirable to convert most of the machines to individual motor drive by the installation of suitable motorized mountings.

Even at the present stage of operation only about 13 per cent of the equipment in the Muskegon plant is entirely new and represents machinery items



New Lees-Bradner thread miller being employed for cutting the Acme thread on the bronze column-raising spindle.

By Joseph Geschelin

Abandoned Factory—

Gun Mounts for Navy

supplied by machine tool builders. This percentage will be increased somewhat as certain other equipment is made available. A number of welding booths have been provided for certain fabrication details and for repair operations. These booths are equipped with Lincoln shielded arc welders.

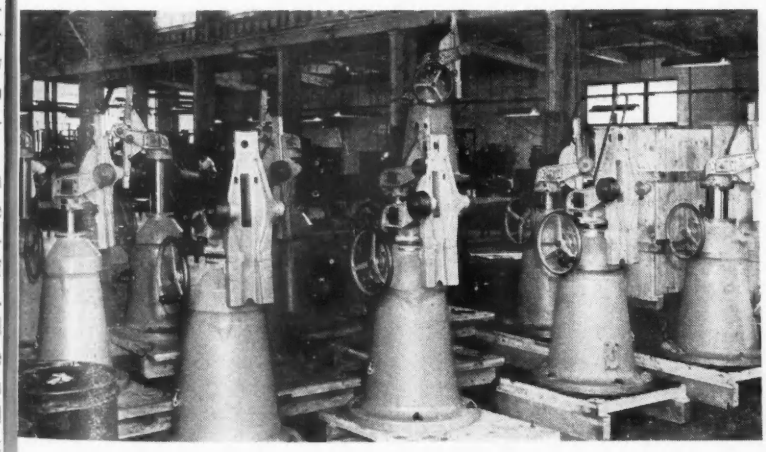
Apart from the problems incident to the commissioning of the plant, the management was faced with the problem of developing a trained force of workers capable of operating the machinery and manning the assembly lines. That this was accomplished with "green" labor drawn from the community is another tribute to the skill of the management group.

Considering this background, it is astonishing to learn that early in 1942 the new company had produced its sample production gun mounts and by the end of September, 1942, had exceeded the monthly schedule requested by the Navy. This achievement may be credited, at least in part, to the development of a comprehensive system of sub-contracting in which the facilities of established concerns were impressed to expedite the procurement of certain parts. This process is still under way and will continue until the existing production facilities are suitably supplemented.

Despite the handicaps of an old mill-type plant comprised of separate buildings juxtaposed on the property, the operation was laid out in accordance with good management practice. The plant is departmentalized, with self-contained functional departments, all feeding to the final assembly lines. This arrangement is along the following pattern—

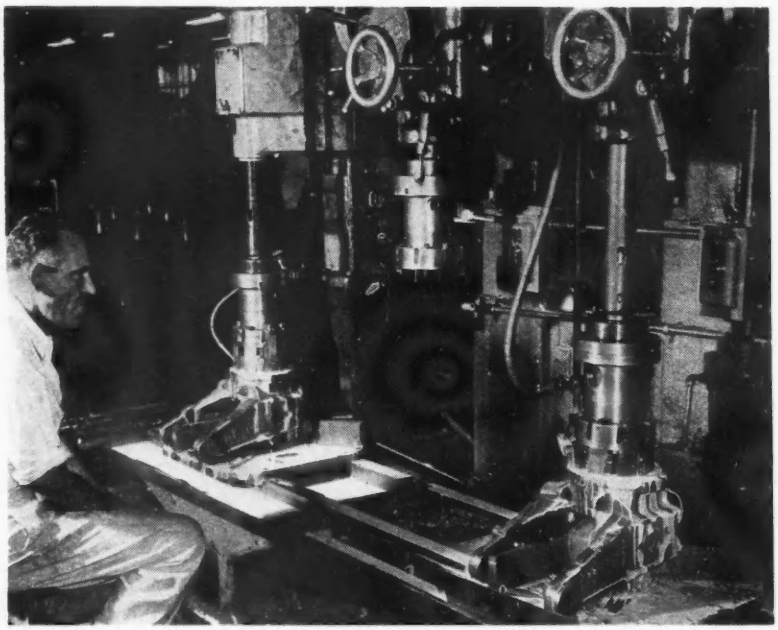
Heavy machine shop
Light machine shop
Pedestal head department
Tubing department
Brass screw machine
Final assembly

From the standpoint of materials handling, they were fortunate in the possession of two good heavy-duty crane-ways which facilitate the handling of heavy castings in the machine shop, and of completed units in the assembly department. Budgit hoists—another Muskegon product—have been provided for each of the



Here is the finished product by NMP—the Oerlikon gun mount — ready to crate for shipment.

One of a group of American Pacemaker lathes in the tube department. This one does the finish-turning of the OD, using cemented-carbide tools.



Example of tooling in the heavy machine shop is found in this group of heavy-duty Foote-Burt drills, boring the trunnion skirt.

machines where heavy parts have to be handled by the operator. A fleet of industrial trucks takes care of inter-departmental transportation. The final assembly line consists of a gravity roller conveyor.

For the most part, the major elements of the gun mount are composed of steel castings and steel tubing, posing the usual problem of heavy chip removal. It is of great interest to find that even in this relatively small-volume operation, they have been successful in applying cemented-carbide-tipped tools supplied by McKenna and Carboloy.

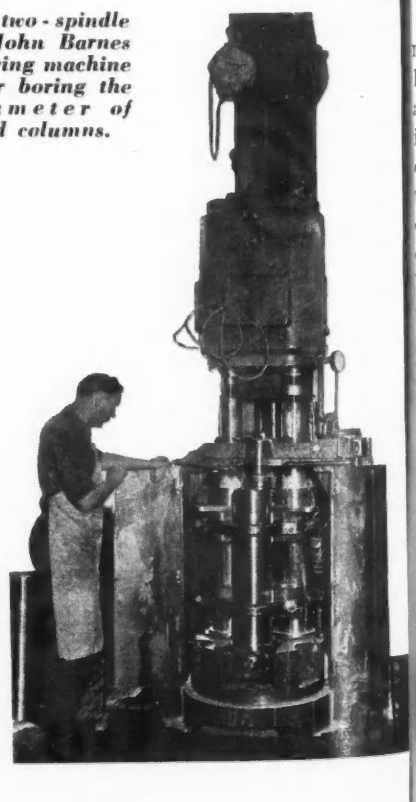
Consider now some sketchy details of the manufacturing departments. The Heavy Machine Shop handles the machining of the large elements—the main pedestal, the cradle, the trunnion. This department is equipped with a variety of vertical boring mills—by Colburn and Niles, and the familiar Bullard V-T-L. Then there are 4-ft American Hole Wizard radial drills, Monarch lathes, new Bryant internal grinders, Baker, Foote-Burt, and Natco drills, etc. In addition, there is a battery of milling machines including some new Cincinnati and Kearney & Trecker mills.

The pedestal is a steel casting weighing 670 lb, rough, which is machined down to 562 lb, marking an average chip removal of 108 lb. The pedestal necks are turned on huge Lodge & Shipley lathes, using Kennametal tools. The trunnion, a steel casting weighing 128 lb in the rough, reduces to 83 lb after the various drilling, boring, and milling operations have been performed.

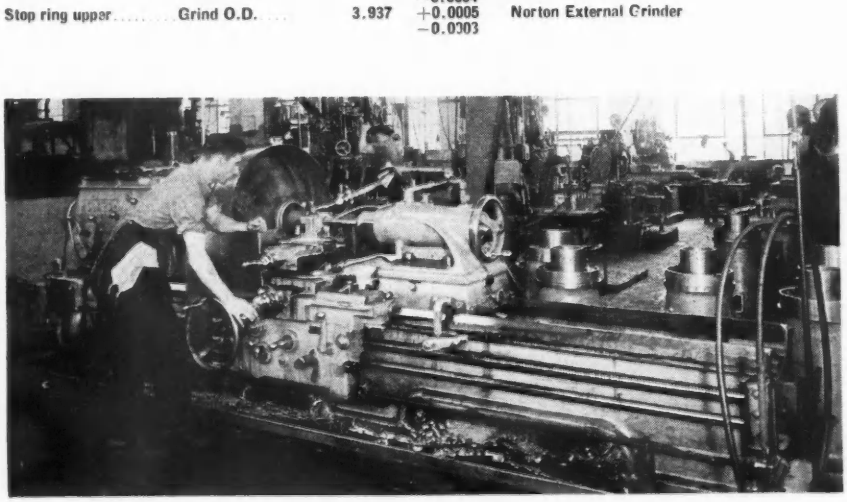
The Light Machine Shop takes care of the machining of some 29 different parts, including bushings of large size, spindles, hand wheel, etc. Among the items of equipment in this department are: Ex-Cell-O pre-

Quality Standards

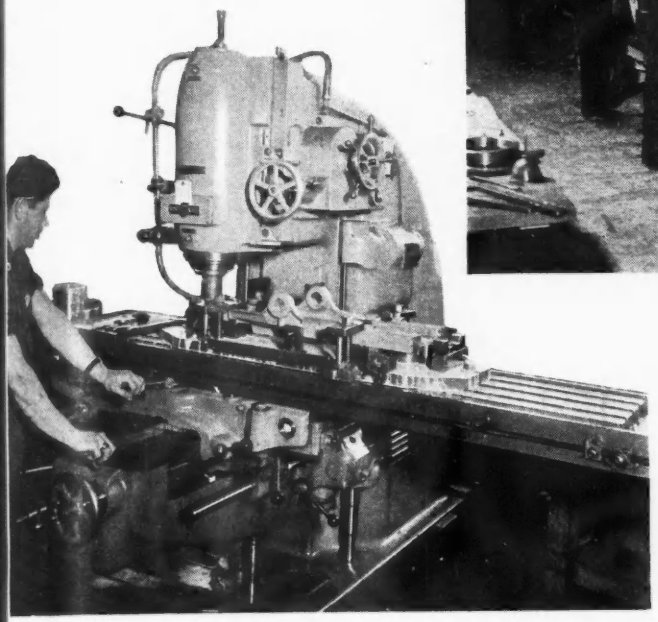
Part Name	Operation	Manufacturing Dimensions and Tolerances		Machine
Bearing bushing lower	Precision bore	5.5123	+0.0005 −0.0000	Ex-Cell-O Precision Boring Machine
Bearing bushing lower	Finish turn O.D.	6.4911	+0.001 −0.000	Sundstrand Automatic Lathe
Hand wheel housing	Finish ream	2.0472	+0.0007 −0.0000	Foster turret lathe
Cradle	Hand line ream (2 holes must be in line)	1.9685	+0.0008 −0.0000	Bench
Column	Grind I.D.	5.1181	+0.0010 −0.0000	Bryant Internal Grinder
Trunnion	Grind O.D.	3.5427	+0.0005 −0.0004	Bryant Internal Grinder
Stop ring upper	Grind O.D.	3.937	+0.0005 −0.0003	Norton External Grinder



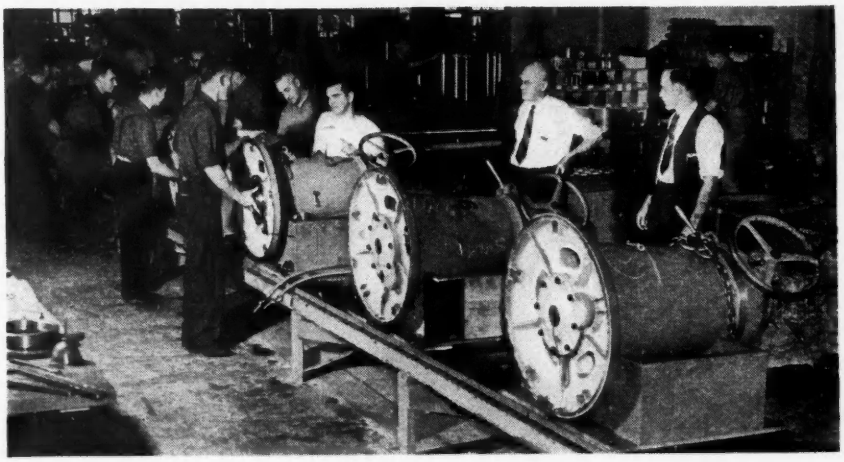
This tall, two-spindle W. F. & John Barnes vertical boring machine is used for boring the inside diameter of tubes and columns.



Here is one of the rugged all-purpose Monarch lathes in the heavy machine shop.



Cincinnati vertical mill, forming the gun breech section of the cradle.



View of the final assembly line with attention focussed on the installation of the column-raising spindle assembly.

cision boring machines, Lees-Bradner thread millers, Cincinnati Centerless grinders, Natco drills, Kearney & Trecker milling machines, Sundstrand lathes.

The Tube and Column Department is devoted primarily to the machining of the heavy tube elements. For example, the column comes in at 183 lb, rough, and is trimmed down to but 83 lb after various turning, boring, honing, and grinding operations. The bulk of metal removal is done with Kennametal or Carboloy tools of steel cutting grades. On the tubing, the first operation is rough-turning of the OD on new American Pacemaker lathes. Tubes are rough- and finish-bored in a special W. F. & John Barnes, two-spindle vertical boring machine. Landis Type C plain grinders are employed for finish-grinding the OD. The bores of the tubes are honed in big Barnes honing machines fitted with Micromatic hones. An internal Acme thread is cut on a large Lees-Bradner thread miller. The inner tube comes in rough at 190 lb and is trimmed down to but 93 lb. It will be observed that the order of metal removal on the tubes exceeds 50 per cent.

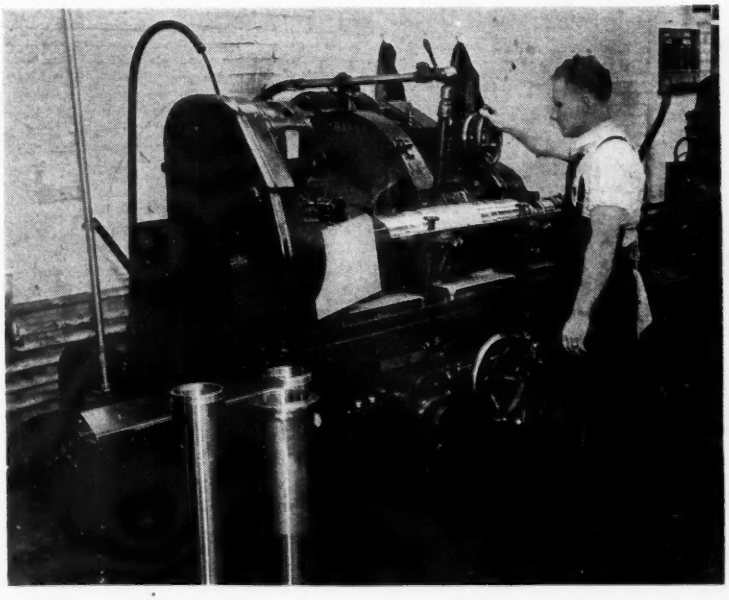
The Brass Departments, so-called, actually handles manganese-bronze worms and pedestal heads, as well as many small items in brass and bronze. The brass screw machine department is equipped with a variety of screw machines and lathes, Landis grinders, Norton grinders, Lees-Bradner thread millers for cutting the worm thread, etc.

Equipment in the Brass Hat or Pedestal Head department, includes the Bullard V-T-L's fitted with cemented-carbide tools, Cincinnati Mills, and many other machine tools.

While it is not practical to outline the machining procedure on each of the parts in the various machine shops, it is important to note that quality, as expressed in fine dimensional tolerances, is the basic feature of the operation. Some impression of the quality standards employed here may be gained by studying the table on the opposite page.

The sketchy outline of the machining departments, given above, at least indicates the general flow of materials through the plant. All of the finished parts are carefully inspected, then transported to the final assembly department. Here the procedure follows the usual practice in the automotive industry. Backbone of the assembly department is the final line. This, in turn, is served by a series of sub-assembly stations placed at right angles to the final line and so located as to feed the sub-assemblies at approximately the points

(*Turn to page* 51, *please*)



Corner of the tube department — Landis plain grinders finish-grinding guide bushings and column.

Air Cargo Presents Many C

Up to a short time ago, air-borne traffic was passenger traffic almost exclusively. The small amount of cargo carried on American airlines consisted largely of luxury goods of high dollar value per pound. When ordinary industrial products were shipped by air, it was usually a case of emergency—to prevent the tying up of large-scale operations by the lack of certain parts or equipment which could be obtained only at some distant point.

All this was changed by the outbreak of the war. There have been many reports of troops in considerable numbers, with the necessary equipment, being carried to points in combat zones inaccessible by other means, and of equipment and supplies transported by air across enemy-controlled waters or to bodies of troops surrounded by enemy forces. In this country the demands on the air lines for the transportation of war material and production equipment have grown rapidly since Pearl Harbor, and the nature of the traffic in many cases has been such as to confront the operators with knotty problems.

The rapid growth in the volume of air cargo naturally drew the attention of operators and of the aircraft industry to the possibilities which this field may offer in the postwar period, when, in all probability, the country will possess a large number of planes of

Requirements in Air-Cargo Carriers

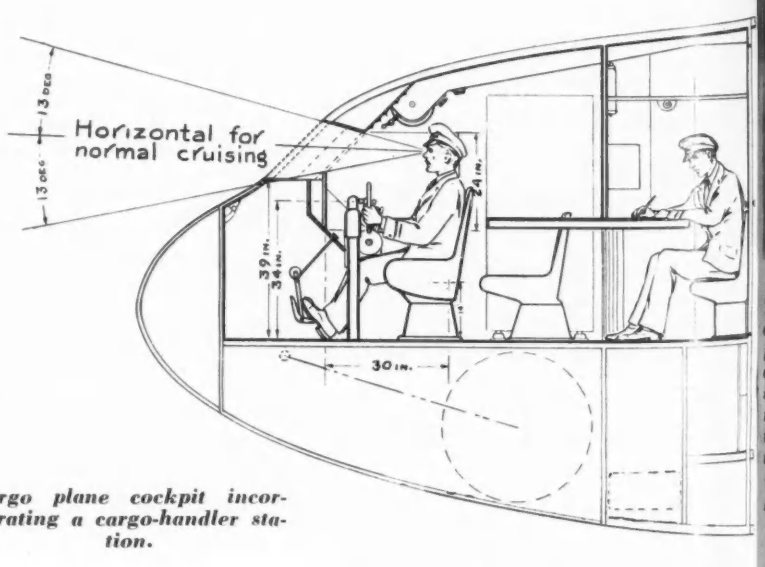
Deficiencies of converted airliners as cargo carriers were enumerated and modifications for future equipment were suggested in a paper by Charles Froesch, chief engineer, Eastern Airlines, Inc., on the basis of that concern's experience in cargo-carrying operations.

The conventional landing gear makes it difficult to load heavy items of cargo, because of the floor gradient, and this difficulty is aggravated by the lack of anchoring points for hoists with which to handle heavy items. Standard passenger-cabin floors are too weak to withstand the heavy loads and rough usage. This can be remedied by either strengthening the existing floor structure or by covering it with an additional floor, preferably of plywood sheathing. Cargo now being offered ranges from very small parcels to automotive units measuring substantially 13 by 6.5 by 4.5 ft and weighing 2500 lb. An additional door, located directly opposite the one now provided is desirable, in that it would permit simultaneous loading and unloading through both doors, and thus save time on the ground.

When the cargo has been placed in the proper location in the plane, there are no means of anchoring the tie-down cables, ropes, or other devices used. Each type of cargo presents a tie-down problem of its own. Some planes have ring tie-down fasteners secured to the floor frame; others have side rails, while still others have a combination of both. Nets also are used, but they must be replaced frequently. As a rule, no provisions are made for a cargo-handler station. There is a lack of simple and concise instructions to the loading personnel as to how to distribute the cargo within the prescribed balance limits. Often it is difficult to place heavy items in the cabin and maintain the center of gravity in such a position that the longitudinal stability and the take-off and landing characteristics will not be impaired. Door-sill heights above ground are different in some planes, which necessitates either lifting or lowering the cargo when loading from a motor-truck platform of standard height. There is a difference of 6 ft 2 in. between the door-sill heights of some planes. This compels the use of such makeshift loading devices as ramps. The usual cross section of the fuselage, either circular or oval, does not permit of maximum space utilization.

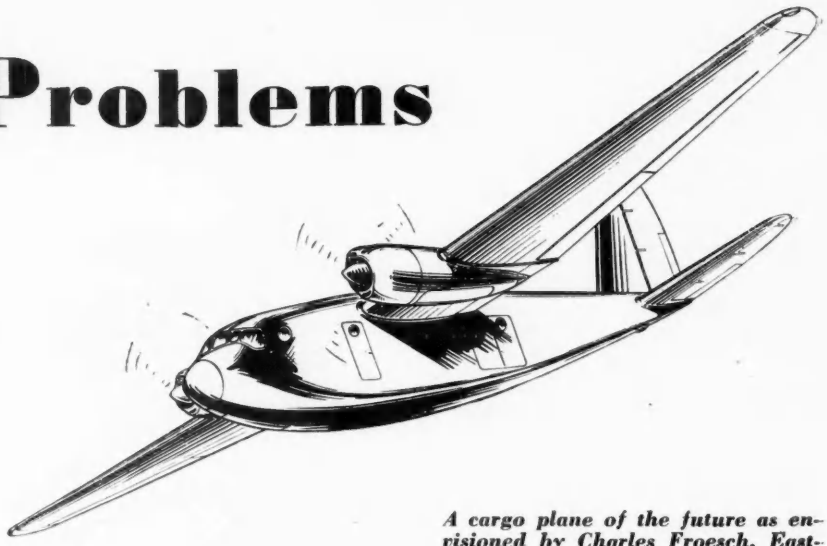
What appears to be the most suitable plane for cargo carrying is a high-wing bi-motor with tricycle landing gear. For larger capacities and longer ranges, however, a four-motor low-wing design may prove superior. The bi-motor construction is advantageous because of its simplicity and low cost. The high-wing construction permits lower door height and easier loading; besides, it provides sufficient wing clearance to permit free movement of ground vehicles without danger of hitting the wing. The tricycle landing gear permits of a level loading floor.

Mr. Froesch made the following recommendations regarding cargo space: The compartment should have a square or rectangular cross section for maximum space utilization. The minimum unobstructed height should be 78 in. to



Cargo plane cockpit incorporating a cargo-handler station.

yComplex Problems



A cargo plane of the future as envisioned by Charles Froesch, Eastern Airlines chief engineer.

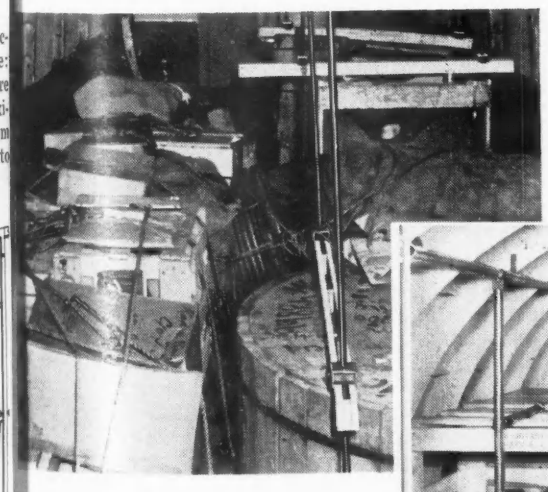
great carrying power, and manufacturing facilities to produce more at a rapid rate. It was, therefore, a happy idea of the Chicago Section of the Society of Automotive Engineers to organize a meeting devoted exclusively to problems connected with the transportation of air cargo. A running account of this meeting, which was held in December, appeared in AUTOMOTIVE AND AVIATION INDUSTRIES of January 1, and following are abstracts of some of the papers presented.

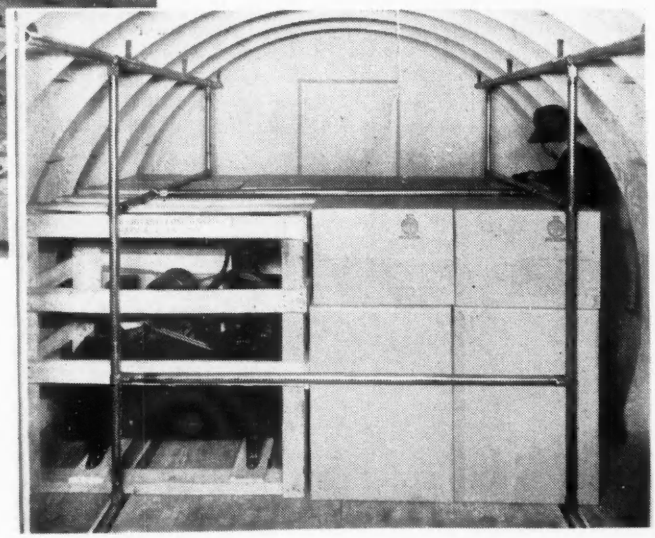
permit walking erect. There should be a large loading door on the left side, and a smaller door for the crew at the front on the same side. Doors should be of such design as not to interfere seriously with loading and unloading, and flush-mounted sliding doors seem to meet the requirements best.

About 90 per cent of express shipments are made in corrugated boxes weighing no more than can be carried by one man; the remaining 10 per cent include items weighing as much as 4000 lb. It does not seem logical to increase the empty weight of all cargo planes sufficiently to safely carry this type of cargo, and the solution of the problem may be found in building a few cargo planes specially for this service.

Railroad freight has an average density of 32 lb per cu ft; rail express, about 9 lb. Improvements in packaging might permit of reducing the express fare about 20 per cent, which would give an average density for air express shipments of 9.5 lb per cu ft. Allowing for unusable space and space near the loading door, which has to be kept clear at all times, a density of 8 to 9 lb per cu ft may be figured with when determining the required size of the cargo compartment.

In the cockpit, space should be provided for a cargo-handler station (see drawing). The cargo-handler's duties would be to keep track of all cargo items, to check and prepare a cargo manifest, to check the destination of cargo, to supervise loading and unloading, to check the center-of-gravity location of the cargo for balance, and to attend to any other "in-flight" duties. A small cargo compartment readily accessible from the cockpit should be provided for valuables, which should be the responsibility of the cargo handler.





Two types of Evans air cargo holddown equipment. (Left) This photo shows the use of two separate methods, the one on the left, side consisting of rope, hooks and rope tighteners and the other on the right consists of tubes with twin wooden cross members. (Right) Another method using perforated tubing with adjustable members.

Holddown Equipment for Aircraft Cargo

HOLDDOWN equipment for cargo in airplanes was the subject of a paper by Col. E. S. Evans, president of Evans Products Co. By way of illustrating the present importance of air cargo in military operations, Col. Evans said the major part of the freight sent to such out - of - the - way places as Iceland and Alaska is moved by air, and larger quantities of freight are now being transported by air from India to China than

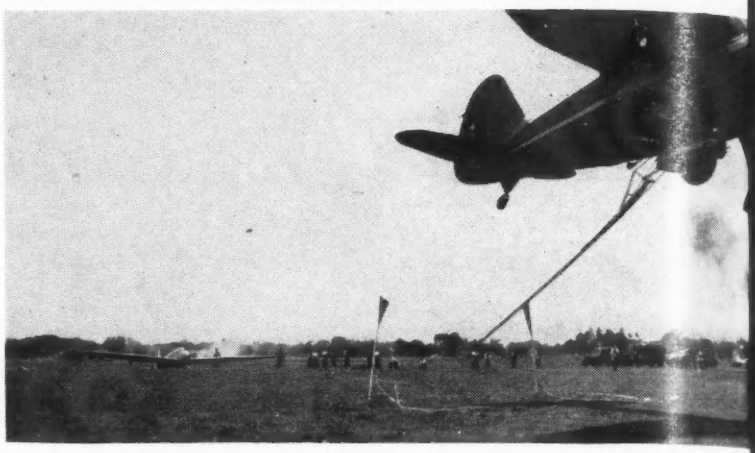
were formerly carried over the Burma Road by 4550 trucks.

Holddown equipment used in a box car weighs as much as 9000 lb. In a plane carrying almost as large a load, the equipment weighs less than 300 lb, and in the planes carrying freight to Alaska the loading material used to fasten down the whole cargo weighs only 100 lb. To combine lightness with strength, materials must be used in the holddown devices which will not stretch permanently under the most severe impact to which they may be subjected. In a cargo carrier a violent downdraft may lift the entire cargo so it will exert an upward pressure of as much as 2.4 times its own weight. If the cargo is not held securely and the plane wobbles, the center of gravity may be so shifted that the plane will crash.

The two photographs reproduced herewith illustrate the methods introduced by Evans Products in the loading of airplane cargos. Most of these devices were designed for use in converted planes, and therefore are more or less makeshifts, as compared with what the final holddown or loading device will be.

One photo shows the interior view of a C-47 which was converted for cargo carrying. Here two forms of air-cargo holddown are represented, one involving rope, locks and hooks, and rope tighteners; the other, tubes with hooks in one end and twin wooden cross members which can be tightened down on the tubes to act as a transverse bar to any vertical movement. The action of the jack or "Persuader" is such that about 1700 lb pressure can be exerted on top of the load for each cross member.

The second photograph shows the interior of a cargo ship in which the loading materials have been built in. This device consists of perforated tubing, two tubes running longitudinally at the top of the plane, and two at the bottom. To these tubes are fastened adjustable members which stand vertically and to which can be fastened cross members. The cross members can be pressed down on the cargo, exerting sufficient pressure to prevent any movement thereof, and can then be locked in position.



Pick-up plane at moment of contact with glider tow-line. Glider in background awaiting pick-up.

Gliders as Cargo Carriers

THE USE of gliders hauled by "tugs" in air-cargo transportation was discussed by Richard C. du Pont, president of All-American Aviation, Inc. He pointed out that what air transport has to offer the traveling and shipping public is speed, and that modern aircraft cannot be operated profitably over routes requiring many stops, because the time lost on the ground neutralizes the time gained while in the air. As a consequence, the domestic air transportation service emerged largely as a high-speed, "through" service between the large centers of the country.

During the past few years much has been heard of pick-up or feeder lines, but little was done in this connection until Congress authorized the Air-Mail Pick-Up routes. The success of these routes revived interest in the short-haul lines. The Air Pick-Up system, which is conducted by All American Aviation, Inc., now operates in Pennsylvania, West Virginia, Kentucky, Ohio, New York and Delaware. Covering communities which range in population from 500 to 120,000 and which are an average distance of 18 miles apart, it constitutes a short-haul operation that a short time ago few in the airline industry visualized or thought could ever be practical or economical. The equipment now in service is designed to pick up a dead-weight load of 50 lb. However, in tests it has successfully picked up 125 lb, and in daily operation it has picked up loads of from 60 to 100 lb without trouble.

Mr. du Pont said he made reference to the air-mail pick up because it was a short-haul service, and in his opinion the short-haul field offers the greatest opportunity for commercial glider operations. To build up a business in the transportation of freight by air it is necessary to reduce ton-mile costs drastically. As a means to reducing operating costs, the glider has attracted attention, and interest in it has been heightened by its successful use in transporting troops and war supplies.

At Crete, and in North Africa, the Germans used two types of gliders, one capable of carrying 23 fully-equipped troops and two pilots, or a freight load of 5300 lb; the other, a craft capable of carrying 10 troops and one pilot, or a freight load of 2800 lb. The freight capacity of the large glider is almost equivalent to that of a DC-3. These gliders were towed by a Junkers 52, a three-engined plane and general-purpose transport and glider tug which can carry a freight load of 4200 lb for a distance of 650 miles and has a cruising speed of 146 mph. It would seem logical that if the capacity of the airplane could be multiplied in transporting troops and military supplies by simply hitching on a glider, the same thing would be feasible also in commercial operations.

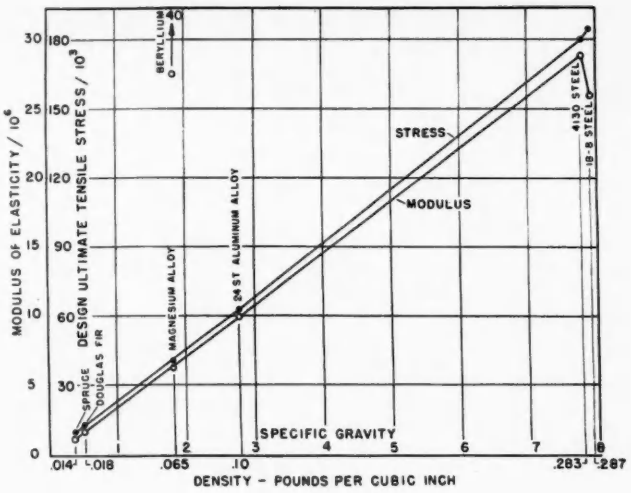
Mr. du Pont said that important advantages are gained when gliders are combined with the Air Pick-Up. He discussed a hypothetical glider cargo operation over a 400-mile route with three intermediate stops, to be operated with a DC-3 plane as a tug. Applying the average ratio of schedule speed to cruising speed—65.56 per cent—this would give a schedule speed for the airplane flying alone over the whole course, of 118 mph.

If gliders are to be used, a formation of three would be hitched to the tug, one for each intermediate stopping point. The combined capacity of the gliders would be equal to the payload of the airplane. "Through" cargo would be stowed in the tug. It may be assumed that the gliders would reduce the speed of the tug by about 25 per cent, or to 135 mph. Making the flight without landing and dropping a glider off at each intermediate station, a schedule speed of at least 120 mph could be obtained. This makes no allowance for the reduced drag due to gliders by dropping one at each station. If a landing were made at each intermediate point to exchange gliders, the schedule speed for the whole course would be reduced to about 105 mph.

On present Air Pick-Up routes the scheduled speed is 89 per cent of the cruising speed of the aircraft. Applying this ratio to the cruising speed of a DC-3 with gliders hitched to it, which has been estimated at 135 mph, a schedule speed of 120 mph would be maintained over the hypothetical route for straight pick-up operations. This would be 15 mph faster than the glider tow-operation previously described and

2 mph faster than the average schedule speed now maintained by DC-3s over a route of this sort.

The opinion has been expressed that glider operation will never be practical commercially because of problems connected with take-off, rough weather, blind flying, and similar difficulties. Mr. du Pont said he disagreed entirely with this point of view. Problems relative to take-off already have been practically eliminated by the adaptation of the Air Pick-Up system to launch gliders. The Germans have used rockets for this purpose. Rough air operations have been made practical by the use of special tow lines and special shock-absorbing equipment. Problems involved in blind flying are being worked on and have already been practically eliminated through special blind flight instruments.



Properties of some aircraft structural materials.

Materials for Cargo Planes

DISCUSSING the subject of Structural Materials for the Cargo Plane, H. D. Hoekstra of the Civil Aeronautics Administration reached the conclusions that aluminum alloy structures probably will continue to lead, because of the high strength-to-weight ratio of the material and the vast accumulation of "know-how" in respect to both manufacturing and maintenance; that stainless steel, however, is a definite contender, particularly under operating conditions involving exposure to severe corrosive effects, and also in large aircraft where the high allowable stresses in the material and the simplicity of spot-welding techniques reduce the bulk of members and attaching fittings, and where provisions must be made against fire hazards, as in the case of structural members in the vicinity of the powerplant; that magnesium alloys appear to have considerable promise, assuming that the problems of corrosion and workability can be properly solved; and wood construction probably will continue to be of somewhat lower rank, particularly in large cargo aircraft, unless smart engineering and outstanding new developments in fabrication processes and protection lead to advances not now predictable.

Reproduced from Mr. Hoekstra's paper is the graph showing the relation between the density and the modulus of elasticity and that between the density and the design ultimate stress for the various materials used in aircraft construction. It will be seen that both the modulus and the ultimate stress go up in direct proportion to the density, so that one material has very little advantage over the others. Only the plot for beryllium lies far from the line representing the average of the other materials. Beryllium compares with magnesium in density and with steel in strength, and it is a pity that it is so rare and so expensive.

The Economies of Air Cargo

J. V. SHEEHAN of Lockheed Aircraft Corporation discussed The Economics of Postwar Carriage of Air Cargo. It seems that an inquiry among airline operators recently conducted indicated that 83 per cent of the operators believe that cargo-carrying facilities should be considered in the design of passenger-airplanes for domestic-trunk-line and primary-connecting operations in the postwar period. The author's firm, however, believes that in order to attain the greatest efficiency—the lowest ton-mile cost—it will be necessary later to develop a plane for cargo-carrying exclusively. Operators, it appears, feel that immediately after the war there will not be sufficient cargo available to warrant the purchase of special cargo-carrying ships. Lockheed's studies indicate that the cargo-carrying field will have four divisions—transoceanic, transcontinental, primary feeder, and secondary feeder. Airplane requirements for cargo-carrying in the domestic field were investigated in detail. Using cost per ton-mile as a criterion, the investigation covered the most desirable size of planes, number of engines, payload, range and speed. It was pointed out in this connection that the types of cargo-carrying planes considered could be licensed for passenger transportation in accordance with present Civil Air Regulations. The investigation thus related to planes which would carry both passengers and cargo. Operating costs were computed with the aid of a set of cost-estimating formulas originally developed for estimating the operating costs of passenger-carrying planes, but modified for application to cargo-carriers. Ten different designs with either two or four engines, developing a total horse power ranging from 2200 to 8000, having cruising speeds ranging from 176 to 219 mph, ranging in take-off gross weight from 26,500 to 100,000 lb, and in maximum payload for a 1000-mile range from 5900 to 30,350 lb. The lowest operating expense per ton-mile was obtained for the largest ship, a four-engined plane of 8000 maximum normal horse power, a cruising speed of 219 mph, a cockpit crew of three, a take-off gross weight of 100,000 lb, a landing gross weight of 92,600 lb, a wing span of 138½ ft, a wing area of 2400 sq ft, and a payload of 30,350 lb. On the basis of a 1000-mile range (50 per cent normal power, no fuel reserve) the total operating expense figures out to 10.12 cents per ton-mile. The same plane will carry a payload of 31,950 lb for a 500-mile operating range, and the total cost per ton-mile then figures out to 9.61 cents.

Airplane Design for Cargo Transportation

AIRPLANE design for cargo transportation was the subject of a paper by Carlos Wood of Douglas Aircraft Co. He discussed the transportation of cargo for both military and commercial purposes. In military operations there is not much choice with respect to cargo destination. Combat conditions bring a whole set of new problems. It will undoubtedly be necessary to provide protective means to cargo planes operating in or near the zone of military operations. For tactical reasons glider tugs may be required, with all of the structural and cooling troubles that result. Some types of glider planes for tactical use will have to be built with much of the design subordinated to the possibility of extremely rapid unloading under fire. (*Turn to next page, please*)

To judge by present trends in both military and commercial cargo carrying, the following are some of the likely developments of the near future:

1. Operation at higher altitude is apparently on its way. Thus we may expect circular section fuselages.

2. The cargo compartment will have a flat floor and will be of the general dimensions of a freight car.

3. The use of airplanes for mixed cargo and passenger loads will call for a re-examination of airplane arrangement.

4. Every attempt will be made to reduce the distance from the ground to the cargo compartment. This may call for some rather freakish designs.

Pre-War Express by Air

PRE-WAR air express traffic was largely in articles or goods used in the process of production, rather than in ordinary consumer goods, said C. G. Peterson, chief engineer of Railway Express Agency, Inc. In pre-war days, machinery, hardware and the heavy industries rated highest in the actual number of shipments and in the percentages of total weight and charges. These shipments by no means were all repair or emergency parts, and the bulk probably were shortages required in production. The regularity with which the heavy industries furnish the most profitable shipments for air express seems to warrant the expectation that they will be an equally-important factor in air shipments in the postwar period. These industries now operate 24 hr. per day, many of them seven days a week; they ship both day and night, and demand immediate delivery.

Printed matter, including both newspapers and periodicals, constituted the next most profitable commodity. Electrotypes, matrices and plates come under the same general classification as printed matter, but they are shipped not as consumer goods, but as equipment used in the printing industry. They moved nation-wide, both day and night, and immediate delivery is required.

Store merchandise probably has received more intensive sales effort than any other commodity moving by air and as a result, while in 1934 these shipments accounted for only 3 1/3 per cent of the total, in 1941 they had increased to 13 1/3 per cent. Motion picture films, most news reels, moved regularly by air. Cut flowers, valuables, jewelry, optical and photographic goods figured prominently in the air express business. News photos and drugs did not constitute as large a part of air cargo as they did in earlier years. Transcription records showed a rapid growth and personal baggage maintained a high average weight and revenue per shipment. Very little food has moved by air for actual sales purposes. The majority of such shipments have been for publicity purposes, or as samples or gifts. However, samples of food, together with raw samples of wool, cotton, nuts, coffee, silk, oil and other commodities, formed a very important part of air cargo. Frequently many are shipped at one time and like cut flowers, they move counter to the flow of manufactured goods.

PRODUCTION LINES

Tank Engines

The Ordnance department U. S. Army is rapidly approaching its goal of a standardized engine for medium tanks. The leaders of the Ordnance organization have explained most carefully why it is that standardization has not been feasible up to the present time. Although the engineering profession appreciates the situation thoroughly, it has been necessary to make the facts known to the general public—to the man on the street. Up to now, the most important thing has been to build a great volume of tanks so as to have fighting equipment for our invasion forces. Very soon it will be possible to establish one basic engine—and go into mass production on it. We await that day with anticipation.

Production vs Spares

Now that the first flush of mass production of the materiel of war has been achieved, the armed forces find that the emphasis on production has obscured the necessity for service tools and for spares—replacement parts. Consequently, the push in many places is for spares and tools. Producers of vital automotive-built equipment have been asked to step up production of spares concurrently with the drive on complete units. This is a most important activity today since even a minor failure in service or due to battle damage can knock out a tank or a boat or a truck.

With Glass

In recent weeks, we note that glass is being tested as a means of replacing critical materials such as tool steel and rubber. In one instance, it has been reported that plug and ring gages have been made of glass and have shown remarkable promise. This project is still experimental. In another instance, glass is being considered for the making of a water pump impeller. If it works, it will eliminate the use of crude rubber or synthetic rubber. Both projects are worthy of consideration and wider exploitation.

Quality Control

Under the spur of the war emergency a fresh approach is being made to the standardization of cylindrical fits in mass production manufacture. This project will be allied with a consideration of standards for gages and gage wear. Accordingly attention again is focussed upon the earlier work of the ASA on standards for cylindrical fits which, presumably, will be brought in line with current developments in metal cutting and with the specific needs of the war program. For best results, the project in question needs must be coordinated with the requirements of the major producers in the automotive industry. To this end, an industry-wide committee is in the process of organization. If those interested in quality control will get in touch with your editor we shall be glad indeed to provide the contact for membership in this group. Incidentally, the formation of an industry group at this time should have a salutory effect upon the course of quality control in the future—after the war.

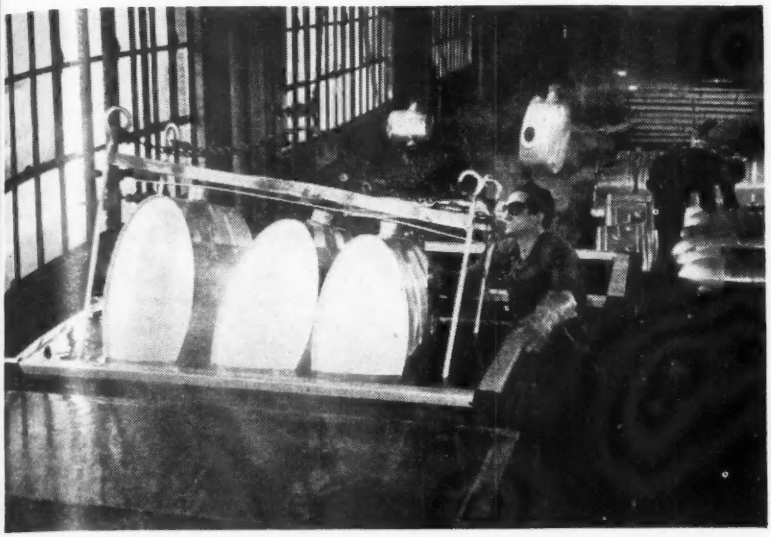
Milling with H-S-S

Important contribution to the art of metal cutting is a little booklet recently issued by Cincinnati Milling Machine Co., entitled "Milling with High Speed Steel." It covers such things as—cutter design, helix angle, tooth form and spacing, mounting of cutters and work, cutting fluids, speeds and feeds etc. We recommend it for your bookshelf.

For Hydrohoners

An interesting project undertaken by Micromatic Hone is the education of users of the well-known and versatile Hydrohoners, in the proper care and use of this equipment. It describes the electrical installation, hydraulic circuit, coolant system, how to set up tools, how to set up table and work reciprocation, etc. It's intended only for users of Hydrohoners. We commend it as a worthy contribution to the war effort.—J. G.

Nitric-Hydrofluoric Bath for



Removing Welding Flux

from Aluminum Alloy Parts

By Paul M. Craig

Aluminum Co. of America

ACID baths are often used to remove the flux from the surfaces of autogeneous welded aluminum parts because of the difficulties encountered when employing mechanical methods, such as scrubbing with steel wool, scratch brushing, etc. This is especially true of fuel or oil tanks, and similar items where portions of the inside are inaccessible.

The solution commonly used for this purpose is sulphuric acid in concentrations ranging from 50 to 150 grams per liter and heated to temperatures up to 65 C. Immersion in this acid solution, followed by thorough rinsing in cold or hot water, is quite satisfactory for removing the flux. However, the slight attack of the acid on the metal, especially at the higher temperatures, is often non-uniform, resulting in a dirty, streaked appearance. The immersion time required is also an undesirable feature since it ranges from 15 to 45 minutes, depending on the condition of the metal surface and the concentration and temperature of the acid solution.

In an effort to eliminate these difficulties the possibilities of using baths containing nitric acid and hydrofluoric acid for removing flux were investigated. As a result of this investigation, it was found that a bath containing 100 grams of nitric acid and 2.5 grams of hydrofluoric acid per liter, and operated at room temperature, dissolved the flux completely in 10 minutes and at the same time produced a clean, uniformly etched surface, free from stains or discolorations that might make further cleaning necessary.

Following is a description of the procedures used, equipment required, methods of control and the precautions necessary when using the nitric acid plus hydrofluoric acid bath for flux removal and cleaning of welded aluminum items.

Procedure

In order to obtain the most satisfactory results with this method for removing flux, three separate baths should be used. They are:

1. Nitric acid-hydrofluoric acid flux removal and etching bath.
2. Cold water rinse.
3. Hot water rinse.

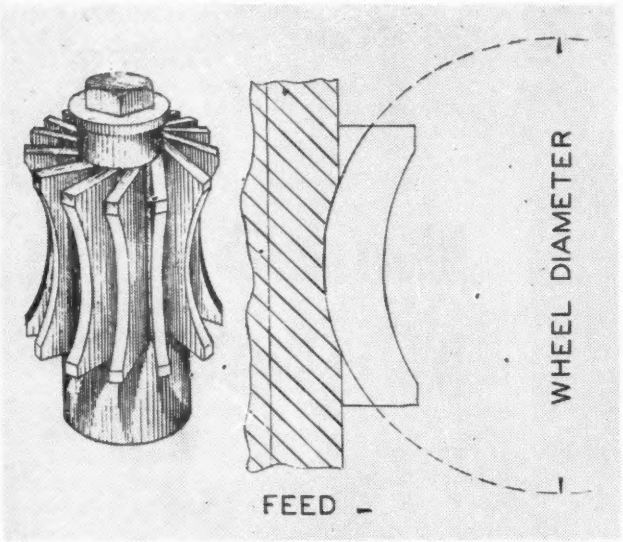
The majority of the flux is removed by directing a stream of water from a hose against the welded area, followed, in some cases, by light scouring with steel wool or scrubbing with a fiber brush. The articles are then wiped with a suitable solvent in order to remove any markings from wax pencils, traces of oil and grease or any matter which might prevent wetting by the acid bath and thus prevent uniform attack of the metal. After these foreign substances have been removed, the articles are immersed in the acid bath for a period of time ranging from 10 to 15 minutes, depending upon the degree of etching desired. Particular care should be taken at this stage in order to prevent the formation of gas pockets. In event the construction of the part is such that not all of the gas evolved can escape, its position in the acid bath should be changed occasionally in order to minimize the effect of the formation of such pockets.

Upon removal from the acid bath sufficient time should be allowed for complete draining, after which the acid should be washed off by immersion in the cold water rinse. Rocking the article or changing its position in the rinse tank is desirable since it sets up small currents which aid in washing the acid from the surface of the metal.

Following the cold water rinse the part should again be drained thoroughly and then immersed in

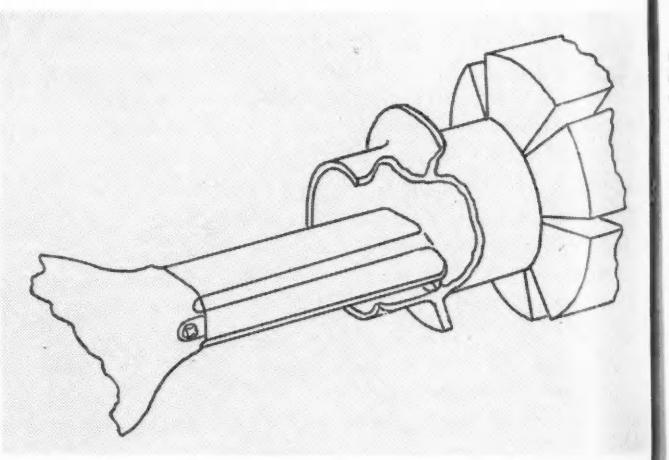
(Turn to page 53, please)

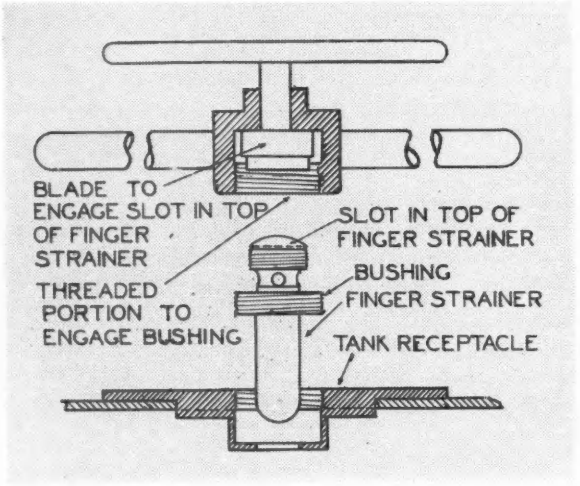
Short C



(Above) A form-cutting tool formerly was ground in the tool shop of Packard Motor Car Co. by clamping the tool to the bed of the grinder in the horizontal position and feeding a small grinding wheel vertically toward it. Owing to the slow feed, the edge of the cutting tool was burned when backing up the grinder, and three operations were required per blade, owing to the small wheel diameter. Following suggestion of Walter R. Kmiecik, the cutter now is held in a simple holding fixture in the vertical position on the bed of the grinder, which has a much faster feed. Thus burning of the tool is prevented and, owing to the larger wheel diameter, only a single operation is required per blade. It is said to effect a saving of about 70 per cent in tool grinding time, plus increasing the life of the tool by 50 per cent each time it is ground.

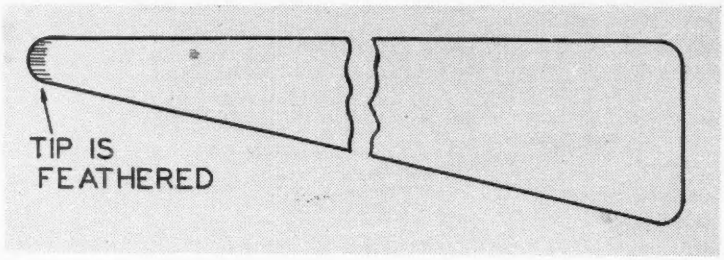
(Below) A cylinder open at one end only, formerly was bored out in a Potter & Johnson turret lathe with a four-bladed cutter, the blades being set 90 deg. apart with flutes between them for the clearance of turnings. However, the turnings often clogged ahead of the cutters, and the machine had to be stopped for their removal. As one man was operating three machines and could not constantly watch all three, this often resulted in damage to the machines. The cutting blades also required frequent sharpening, as it was difficult to maintain a constant flow of coolant on them. The new tool holder with a single blade at the bottom, shown in the sketch, overcame these difficulties. Coolant flows through the holder and onto the cutting surface from a point just above the cutting blade. With the cylinder revolving, the cutting edge is constantly immersed in coolant. There is no difficulty with the clearance of cuttings. The production was increased from 7 to 21 pieces per shift by this improved cutter, which is due to Loomis I. Walden of the Packard Motor Car Co.



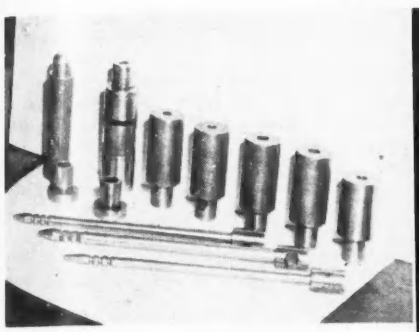


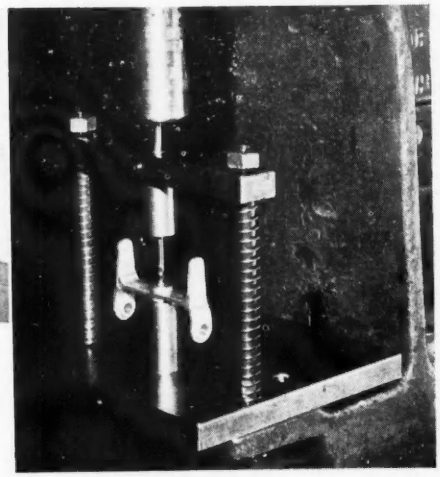
(Left) A tool that will facilitate the insertion and seating of bushings and strainers in aircraft fuel tanks has been devised by Marvin Crawford of the Bell Aircraft Corp. It consists of a combination wrench which receives the bushing and strainer, and it embodies means for locating the strainer threads in the bushing so that the bushing may be worked into the tank receptacle. Then, by unlocking the threads, the bushing and strainer may be properly seated in the tank receptacle. This tool is said to speed production and to avoid difficulties due to crossed threads.

Cuts



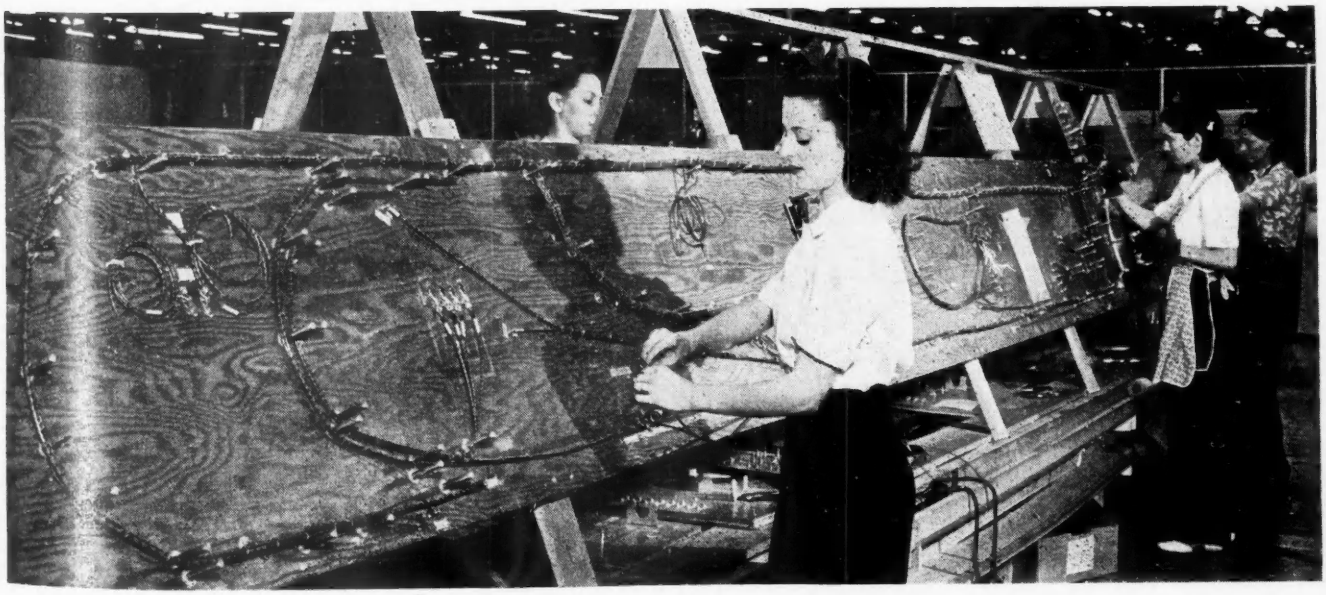
(Above) When removing dents around rivet holes in airplane skins with a fiber mallet, it has been customary to place a steel scale over the stringer to back up the skin metal. If the dent area was larger than the width of the scale, the skin often stretched under the blows of the mallet. John A. Wilson of the Curtiss-Wright Corp. devised the tool shown herewith, which is of tapered width and can be used for dents of up to about 1⅜ in. diameter, providing in each case a flattening surface of the proper width. This tool, which is made of stainless-steel scrap, has been in use in the Control-Surfaces Department of the Curtiss-Wright St. Louis plant for some time and is said to have proven entirely satisfactory.





(Above) A simple but unique mechanism which is a combination broaching tool and burnisher used to complete the hole roughed out in Oilite bushings has been developed at the Douglas aircraft plant. The tool is attached to the standard shop hand press with lever action. It consists of a bar, guide and bushing holder, the bar having a cross section similar to that of the hole to be formed. Provided on the surface of the bar are a series of cutting edges each of which lies in a plane at right angles to the axis. The broach is fed through the bushing and, since the cutting edges are progressively higher, each succeeding tooth removes an additional amount of metal. A slightly greater diameter, semi-round in shape and a part of the bar is then forced through to burnish the hole just broached. All is done now in one simple operation and 60 per cent of the time is saved over the old method which took two distinct setups and double handling of the press. Ninety per cent of the bushing work in aircraft production can be done with this type broach and burnish tool.

(Below) Although the basic principle of wiring boards is not new, this setup at the Vega aircraft plant incorporates a number of improvements that speeds up the assembling of electrical wiring harnesses for Flying Fortresses. These boards are designed to permit the simultaneous assembly of several harnesses, which results in a better labor load distribution and maximum utilization of the assembly board and space. Another feature is that the boards are placed nearly vertical with a consequent saving in floor space and greater convenience of wiring. Prior to assembly, wires are continuously coded by running them through a Vega-designed printing roller. The wiring boards also can be used as test boards for checking the continuity and resistance of the circuit.



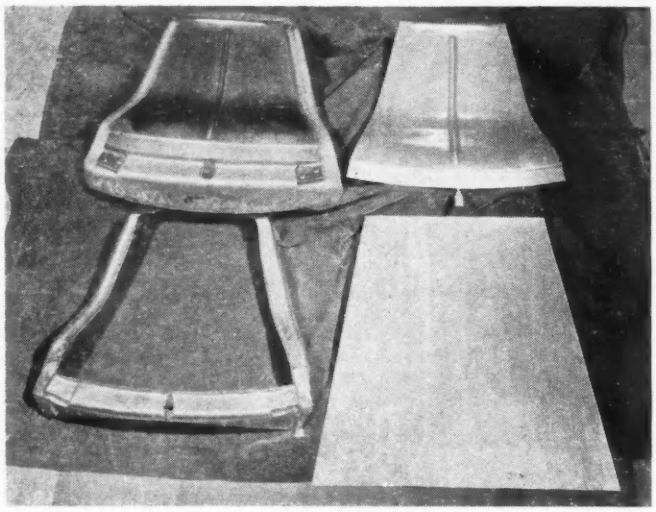


Fig. 1—Combination shear and form die. Die and scrap at left. Completed part and unformed, uncut blank at right.

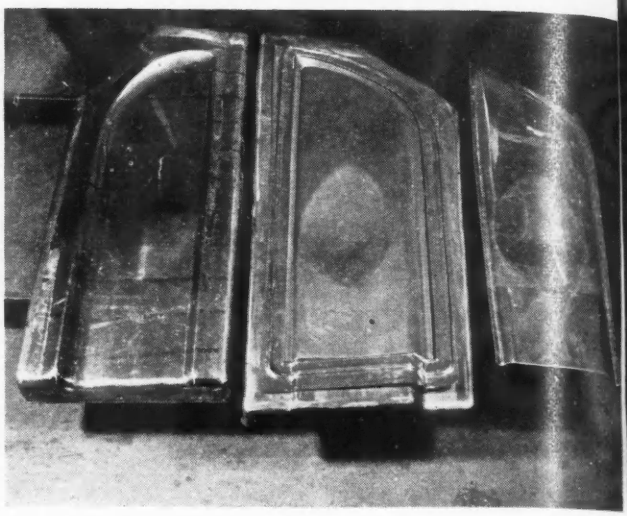


Fig. 2—Set of dies used for forming, sizing, and trimming inner skin of door assembly. At the left is the forming die. In the center is the shear die, and at right is the completed part.

Some Recent Developments in

By P. L. Smith and V. L. Brooks

Methods Analysis Engineers, Douglas Aircraft Co., Inc.

DURING the past ten years the aircraft industry has adjusted its methods and its thinking to the all-metal airplane. The transition from methods suitable for wood and fabric construction to newer methods for sheet metal fabrication was severe and was accomplished by improvising and by wholesale borrowing.

The borrowed processes, such as power brake forming and punch press die shearing and forming have been used by the aircraft industry in ways that are in the main conventional. They belong to the folk-lore of all industries in which sheet metal fabrication plays a prominent part.

The processes improvised or originated by the aircraft industry represent steps in the progressive solution of problems that belong specifically to aircraft. They include the Guerin Process for forming sheet metal parts by means of a single die and a contained rubber pad, the router process for blanking small quantities of parts with speed and precision, and the drop hammers which are used to form small numbers of parts to complicated shapes or contours.

These processes are well represented in the technical literature of the past five years and for that reason a general understanding of their application to fabrication problems in aircraft may be assumed. But many of the refinements which they have undergone in recent months have not yet been made available to other industries. A few of these refinements are discussed here.

Several significant refinements concern the Guerin Process. The manufacturing efficiency of the process has been greatly increased by the provision of more than one table for each press unit. The change permits the forming of one table of parts while another is being loaded or unloaded. Presses have been equipped with as many as six tables, and units so equipped have been used to form 18,000 parts in an 8-hour period.

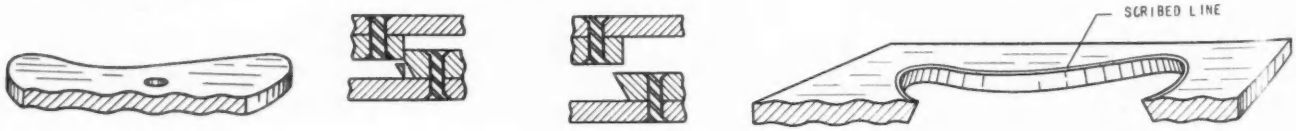
Further economies in the Guerin Process have been realized through the use of combination shear and form dies. These dies have for the most part been made from Kirksite, which is a zinc-aluminum alloy.

Fig. 4—Below on this and the facing page is shown the pierce-blank template die developed at Douglas Aircraft Co.

A—Steel punch cut to outline of blank. Note piercing hole.

B—Female die cut from Kirksite. Cut is made at a bevel and inside of scribed line.

C—Male die broaches female producing a zero clearance die.



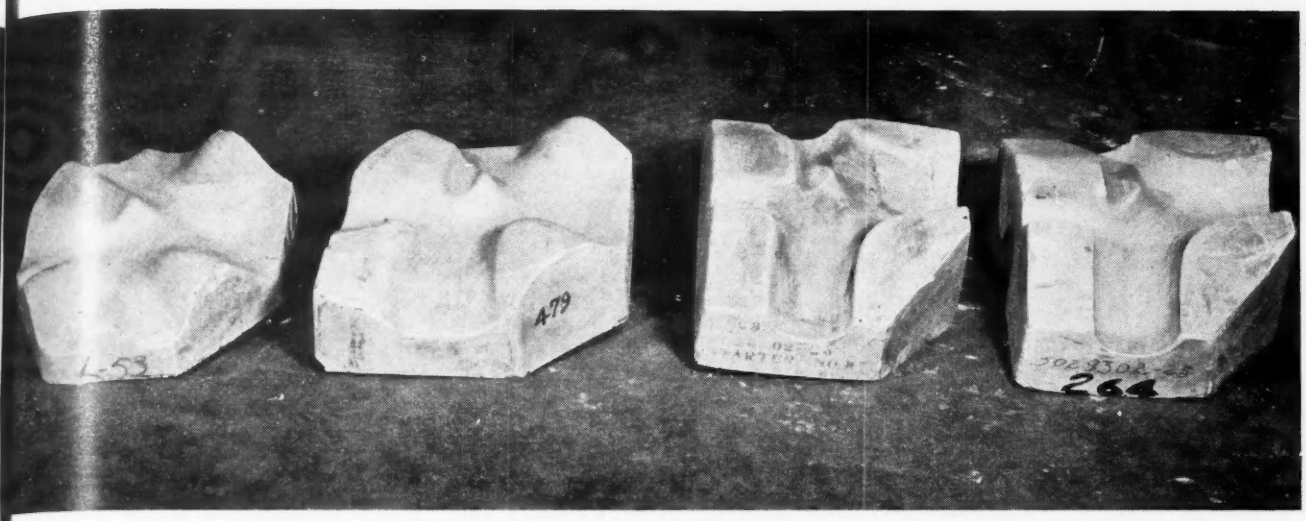


Fig. 3—Staged dies for progressive drop hammer forming of an air duct.

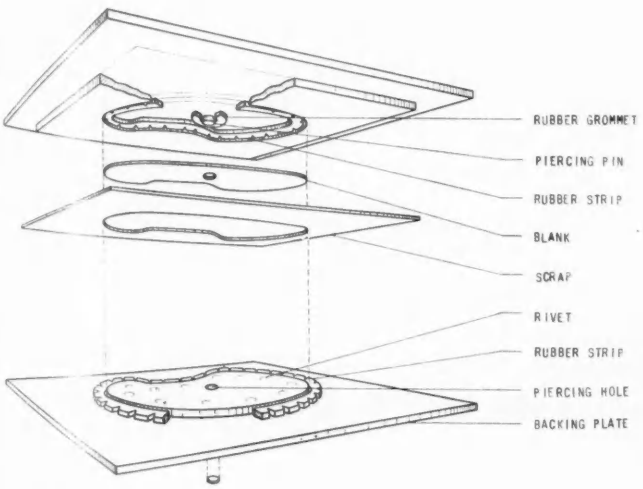
ts in Sheet Metal Fabrication

As shown in Fig. 1, sheet material cut to approximate size is placed on the die. The press rubber forms the sheet to the die and causes it to be sheared along the shearing edge. In many cases the forming required cannot be accomplished on a single die. For such parts a shear and form die of the type shown in Fig. 2 may be used. This die serves only to shear and size the part.

Some novel details may be incorporated in sheet metal parts by taking full advantage of this shear and form process. A one-piece door can be made to incorporate a depressed center panel and crimped edge. The crimping operation is usually considered difficult to perform but by the proper placement of shear plates on the die it is possible to crimp the edge and form the part in one hit of the press.

Another improvement in Guerin Process technique concerns the manner in which dies are manufactured. These dies originally were made from masonite, a pressed wood compound which is purchased in slabs and fabricated by means of wood working tools to the desired die shapes. Recently, however, investigations have been made into the use of plastics and it seems entirely probable that in the future hydro press dies will be formed by casting a plastic into a mold. Not only will the manufacture of the dies be simplified, but more than one die can be made so that several identical parts can be formed with one hit of the press.

Although the drop hammer has been replaced—at least to a certain degree—by the stretcher press and the draw press, refinements have been made in drop hammer die technique which make the drop hammer suitable for forming a great many different parts. The biggest refinement has been the use of staged dies. It has been found that by employing a number of dies, each of which progressively forms the material, parts can be made more rapidly, with less spoilage, and less hand work required than with the older methods using but one die and relying on the skill of the hammer operator plus the use of rubber strips, hand mallets, etc., to form the part. Fig. 3 shows a set of 4 staged dies used to form an air duct. (*Turn to page* 53)



(Left) D—Completed pierce and blank die (PBT).

(Below) E—Cross section of a PBT die set. For clarity, dies are shown with a slight clearance. In actual practice the clearance is zero.

Refining

of Used Crankcase Oil

CRANKCASE oil is not used up in the same sense that fuel is used up, for instance; it is merely contaminated with foreign materials, such as fuel fractions, dust and metal particles, and coke and sludge which are formed by the action of heat on the oil. If these contaminants are eliminated, the oil is practically as good as new, and suitable for further use. Certain contaminants can be removed by centrifuging or filtering, while diluents such as fuel fractions can be removed only by distillation.

In a paper on Re-refining of Aircraft Engine Oils, read at the S.A.E. National Fuel and Lubricants Meeting by Gilbert K. Brower of American Airlines, Inc., the author divided methods of rendering used crankcase oils available for further use into reclamation and re-refining. He classifies as reclamation any method of process which removes only water and solid substances (insoluble in petroleum naptha), but not dilution or other products of decomposition. This method he recommends for oils not subject to decomposition and for treating used oils to prolong their useful service life. Such methods as centrifuging, mechanical filtration, etc., come under this heading.

By re-refining he means a process which will restore used oils so they have practically the same characteristics as new oils. Such methods should include clay contact, vacuum distillation, steam stripping, etc.

Typical Re-Refining Cost Data Refinoil Unit—American Airlines' Process

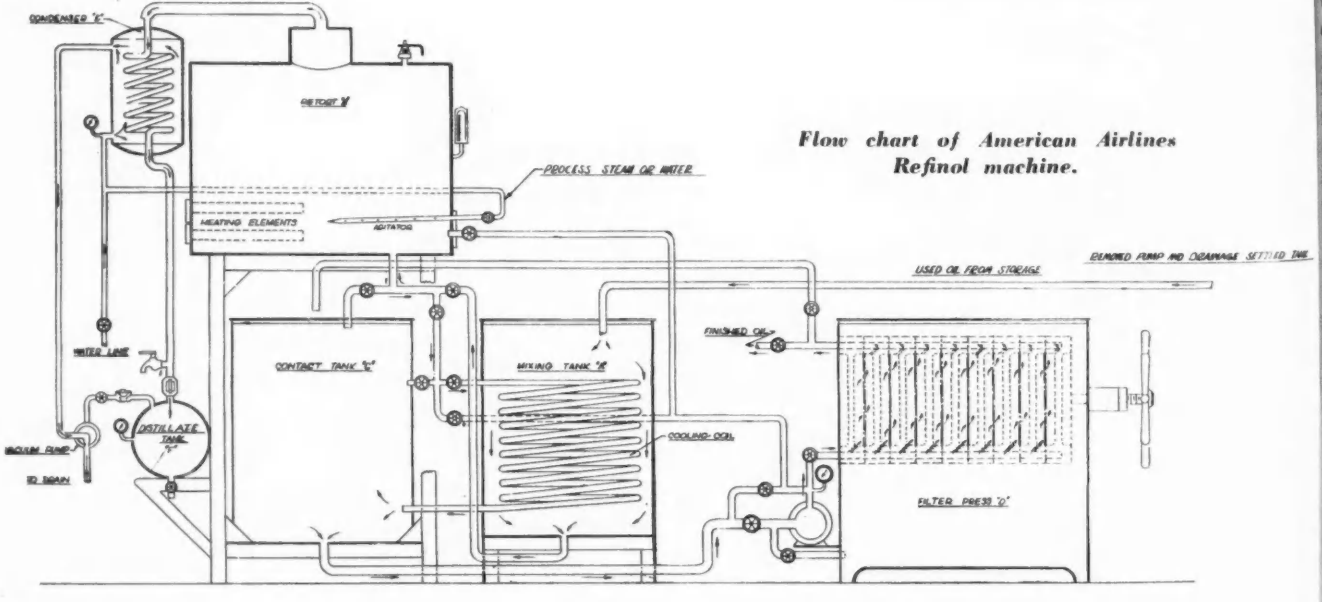
10 per cent concentrate	$0.0555/gallon
Earth (Retrol)	0.0147/gallon
Filter Aid (Johns-Manville Hyflo Super Cel)	0.0046/gallon
Filter paper	0.0034/gallon
Labor	0.0418/gallon
Depreciation	0.0100/gallon
Maintenance	0.0100/gallon
Electricity (estimated)	0.0100/gallon
Total Cost	$0.1500/gallon

American Air Lines, Inc., began re-refining its used engine oil about twelve years ago, when units of several types were installed at Dallas, Newark, Cincinnati, St. Louis and Chicago. At present all operations are carried on in a single unit at New York, as 90 per cent of all oil changes are made there, after approximately 100 hours of operation.

In his paper Mr. Brower described seven different processes for reconditioning oil. We will confine ourselves here to the last one described, Unit G, the American Airlines' Refinoil unit. This unit, which is illustrated here, is operated as follows:

The used oil is mixed with an activated earth in a mixing tank *A* and then drawn by vacuum into an electrically-heated still or retort *B*, where it is raised—under controlled vacuum and steam-stripping—to a sufficiently high temperature to strip off dilution, mois-

(*Turn to page* 48, *please*)



Flow chart of American Airlines Refinol machine.

PT mosquito boats at a dispersal point.

International News

World-wide Field Service

Maintained by Packard

for PT Boat Engines

By E. L. Warner, Jr.

PACKARD-POWERED PT boats, which gained fame for carrying General Douglas MacArthur out of Corregidor to safety in the southern Philippines, are now operating over a wide area extending from the Solomons to the Mediterranean and England's coastal waters. Every Packard marine engine that goes into these PT boats carries a 90-day warranty from the factory. To insure the terms of this warranty as well as to see that the marine engines are properly serviced, Packard has 16 field service representatives located at strategic points in various parts of the world.

The field service representatives, under the direction of George H. Brode, marine division general manager, are given a six-month training course in marine engine manufacture and maintenance at the Packard factory in Detroit. Packard has trained about 25 of these men since the first Packard marine engines were installed in the PT boats early in 1940. Some of them have left Packard to become civilian employes of the Navy Dept. Some are sent to foreign ports in England, Hawaii and Australia to help supervise the maintenance of the PT fleets. Others remain in the U. S. to serve as liaison men between Packard and the shipbuilders that make the PT hulls. Three service experts accompanied the first shakedown cruise of a dozen PT boats from New York City down the Atlantic Coast to Cuba and return.

The Packard field service men are trouble shooters for the squadrons. The 70-foot craft carry an eight-man crew, only two members of which are machinist's mates who care for the two or more engines aboard. These men have had a two-month course in marine engine operation—a month at the Packard plant and another month of training on the boats under operating conditions. If any major overhauls have to be undertaken, a field service man may be called in to supervise the job.

Every PT boat carries a complement of a few spare parts for normal repairs, such as carburetors, magnetos, gaskets and water pumps. At the PT bases enough parts are maintained to provide two base overhauls apiece for 50 engines.

The field service representatives run into some unusual problems. On one craft the cotter pin dropped off the throttle while the engine was idling. A runaway engine developed and it attained 4000 rpm before a sailor could stop it by shutting off the gasoline supply. Now the engines are equipped with automatic ignition cutoffs that cut the engine if it exceeds the normal maximum of 2500 rpm.

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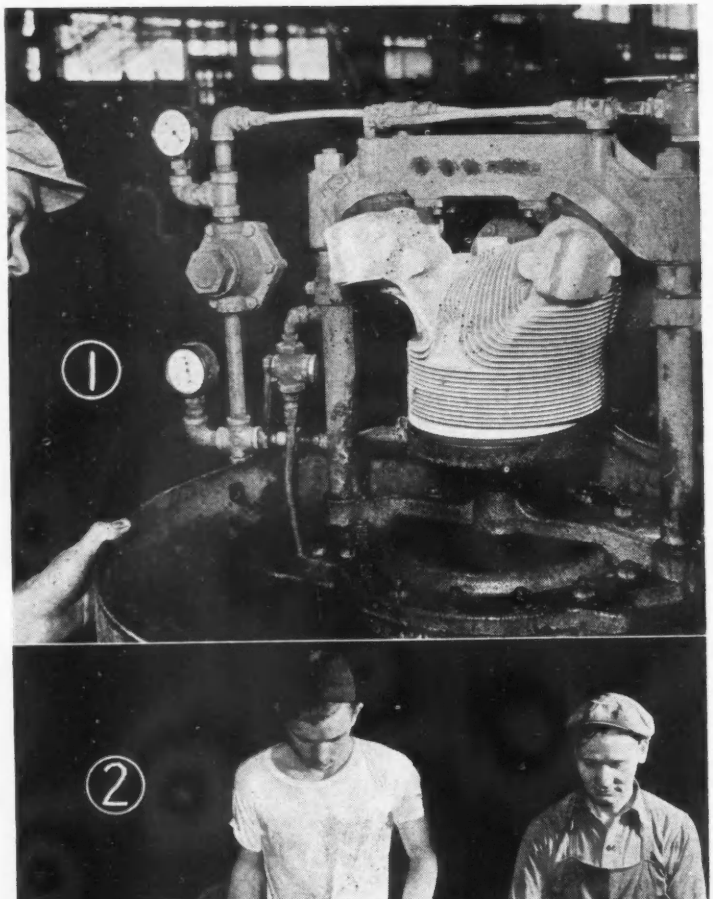


Buick Aluminum Foundry Embodies

Best P

STARTING from scratch — and without previous specialization—the foundry management of Buick Motor Division, General Motors Corp., has developed an aluminum foundry operation which is said to be one of the finest in this country. Devoted exclusively to the production of aircraft engine cylinder heads, the Buick foundry has been skillfully planned along mass production lines borrowed from motor car practice. It embodies novelties in technique and equipment that have gone a long way to improve quality, reduce rejects, and to raise the ceiling of productivity.

Buick's foundry experts began the project with unbounded confidence backed by many years of gray iron foundry experience and a long record of successful trouble-shooting which were brought to bear on the requirements of aluminum foundry practice. And in the process, they were quick to take advantage of the cooperation and previous experience of organizations already in the field. The net result is a plant that stands apart due to the integration of accumulated experience, including the special recommendations of many equipment suppliers.

Apart from plant layout, the Buick foundry exemplifies certain basic principles which exert a profound influence on the success of the project. Doubtless, the most important of these is the fact that the plant has been laid out for the production of but one type of head. That feature alone has made it possible to create a single-purpose mass-production unit of high productivity and relatively low unit cost. The gray iron foundry experience led to the insistence

1—Unique hydraulic testing machine for testin the soundness of castings.

2—Use of massive steel core assembly fixtures i illustrated here. This type of equipment accoun for the accuracy of the process at Buick, is re sponsible for a record of low rejects.

3—Another of the basic control operations is th "sooting" of cores as they move down the conveyo to the assembly station.

Practices for Mass Production

of Aircraft Engine Cylinder Heads

upon precision-built, massive pattern equipment, resulting in perfectly fitting and completely interchangeable cores. This accounts for the beautifully fitted mold assemblies and the perfection of casting detail, particularly as to the quality of the fins, and exceptionally low scrap loss.

Coming to the matter of foundry technique, Buick has high-lighted four factors responsible for exceptional control of quality. These are:

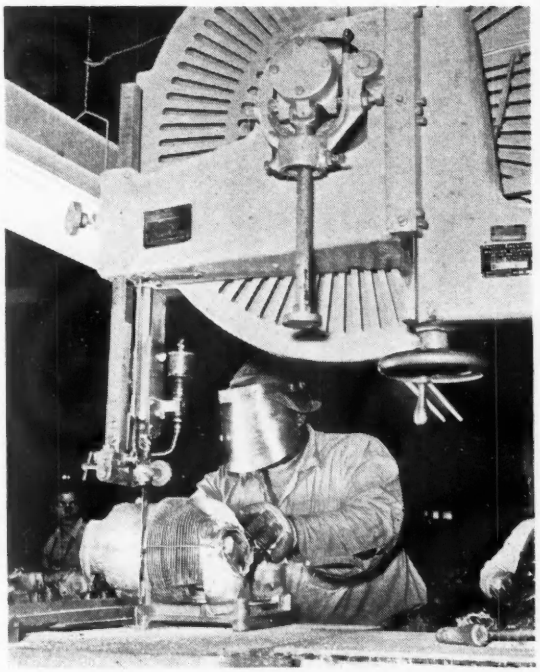
1. Control of facing sand.
2. Technique of spraying cores.
3. Technique of smoking or sooting of cores.
4. Control of melting and pouring temperature.

In many respects, Buick is fortunate to have been able to draw upon the experience and problems of other foundries already in the field. Consider, for example, the matter of sand reclamation. Only a new foundry could provide in its planning an adequate reclamation system capable of coping with the current shortage of silica sand. As will be described later, Buick boasts a unique system for this purpose, making possible the recovery of almost 100 per cent of processed sand. The bulk of this sand is used for backing, the remainder is "burned" in special kilns for facing sand.

It is important to note that through the operation of the sand reclamation system, Buick has reduced its requirements for new sand to about two carloads daily. Not only does this relieve a critical shortage of what has become a scarce commodity, but it also has relieved pressure on vital transportation facilities and has assured the uninterrupted operation of the foundry under the most trying war time conditions. Other foundries may well profit by these results and by drawing upon the resources of the equipment producers who have cooperated in this project.

As a commentary on good management practice, it may be noted that before the layout of the new foundry was "frozen," a small pilot operation was set up in Buick's gray iron foundry to sample the effectiveness of special equipment and of the techniques that had been adopted. This pilot plant proved capable of turning out a volume of cylinder heads far exceeding the most optimistic estimates and eventually formed the first unit of the new foundry.

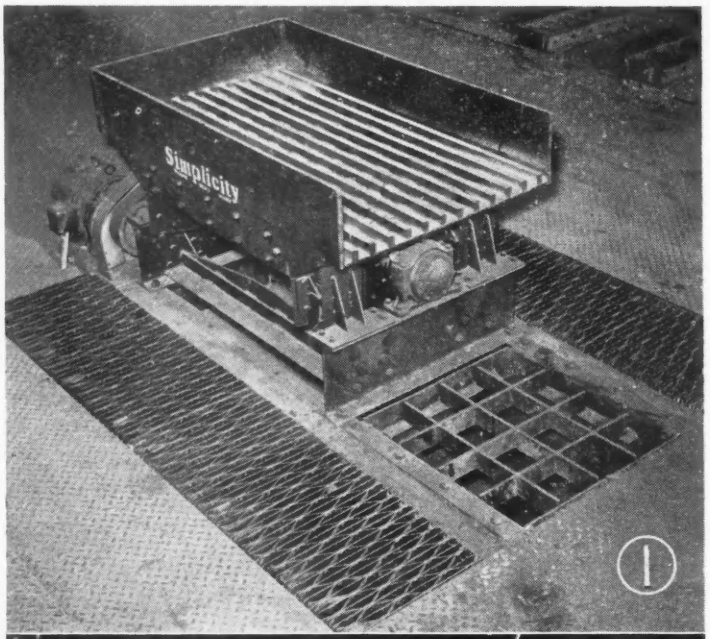
Consider now some of the features of the aluminum foundry. The foundry proper houses four self-contained units for molding and pouring, arranged in parallel rows. Each of these units consists of two separate molding lines containing molding machines, core-blowers, two core-baking ovens, and one drying oven. At the end of the line each unit has its own pouring station served by a battery of twelve 1000-lb melting furnaces. A feature of interest with respect to the pouring lines is that Buick has found it desirable to pour on stationary tables rather than on moving conveyors.



One of the details contributing to an unusually economical recovery of aluminum scrap is this operation of cutting off the riser section on this Yates American Machine Co. heavy metal saw.

Immediately after the pouring stations is the shake-out for each unit. Here again are some features that have a bearing upon the economy of the operation. In the first place, Buick uses a special Simplicity vibrating grate in which the mold is knocked apart completely. The burnt sand does not drop through the grate but, instead, it is swept off into a chute at the side, down to the sand reclaiming unit. Then the entire riser is cut off and all excess metal is picked off on a bench. This procedure prevents metal from mixing with the sand, simplifies sand handling, and provides the maximum of metal salvage.

The castings now move down the department to the cleaning room where they



are chipped on the benches, the fins ground on special grinding machines, then shot-blasted in Pangborn machines. Next follow buffing operations, another shot-blasting in a secondary Pangborn machine, winding up this sequence with the water test.

Following this stage the castings move to the heat treating department where they are heat-treated in Lindberg, square, pit-type furnaces. They are removed from the furnaces for air-quenching and cooling by forced draft on turntables, then are placed in another battery of Lindberg pit-type furnaces for the aging treatment. In the heat treating department, the heads are handled in large rack-type fixtures holding 120 heads at a time. Upon completion of the heat treating cycle, the heads are shot-blasted again, then subjected to final inspection, Brinell hardness testing, etc.

The heads are now ready for shipment. They are placed on a conveyor which transports them to an automatic carton glueing machine for packing and marking. However, none of the cartons may be shipped until the test bars corresponding to each heat have been certified by metallurgical laboratory test.

Thus far we have touched briefly on the high-lights of the main foundry section. Retracing our steps to the front end of each of the molding units, we find a section devoted to sand handling. Here are the sand storage and sand mixing units, also the sand reclaiming unit, with one such group for a bank of two molding units.

Flanking the molding units, along the side walls, are the re-melting stations. It may be noted at this point that Buick was required to operate a completely self-contained foundry, even to the extent of producing its own alloy pigs. Virgin metal is brought in from the outside but it must be suitably alloyed and cast into pigs at the foundry. In addition, it is necessary to salvage by re-melting and refining all of the scrap, findings, gates and risers resulting from the foundry operation.

The office section of the foundry at the extreme front corner of the building has complete facilities for chemical and metallurgical laboratory work. Among these de-

1—Close-up of one of the Simplicity knock-out stations. The large grid at the side is the opening to the chute which carries the material to the Bartlett-Snow breaker mills in the basement.

2—One of the rotary tables used for cooling the cylinder head castings after heat treatment and prior to aging.

3—Assembly of dry sand cope and drag section into a finished mold. This is taken off at the right, ready for transport to the pouring table.

partments will be found the "wet" chemical, metallographic and sand control laboratories, an X-ray room, spectographic department equipped with a new Arl-Dietert large quartz spectrograph, and many other facilities so essential to precise metallurgical control of an aluminum foundry operation.

With this background, we may examine the molding process more closely. In the first place, the heads are cast in dry sand molds (without the use of flasks), consisting of a drag and cope section assembled with combustion chamber core and two rocker box cores securely and precisely positioned in the mold cavity. The cope and drag are made up in Osborn semi-automatic rollover swingout type molding machines with hydraulic draw mechanism, of extra heavy construction to provide ample rigidity for a precision job. Combustion chamber and rocker box cores are produced by core blowing. After the cores are baked and cooled, they are checked for dimensional accuracy with metal gages of flush-pin type. Then they are blown and sprayed with a fluoride solution.

After going through the drying and cooling oven, the drag and cope go to an assembly bench where the cores are set in place, using a special fixture to assure accurate alinement. The end of the combustion chamber core is so designed as to serve as the pouring gate. One of the critical operations mentioned earlier is the sooting of the two halves of the mold before joining them. This is done with a swinging acetylene burner flame properly adjusted as to quality and length of flame. The assembly operation is handled in a special fixture built into the roller conveyor. This terminates in a preumatically controlled table on which the drag and cope assemblies are joined and locked by an air cylinder. Then the assembly is rolled over and lowered into position for hoisting onto the pouring table.

In addition to accurate control of melting and pouring temperature, the pouring ladles are accurately gaged as to amount of metal they hold. Before the charge is poured into a mold, the surface dross is carefully

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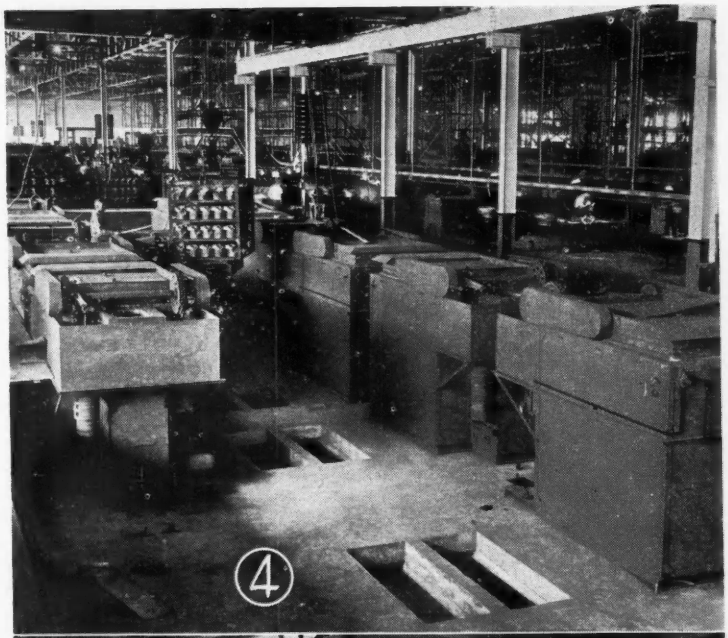
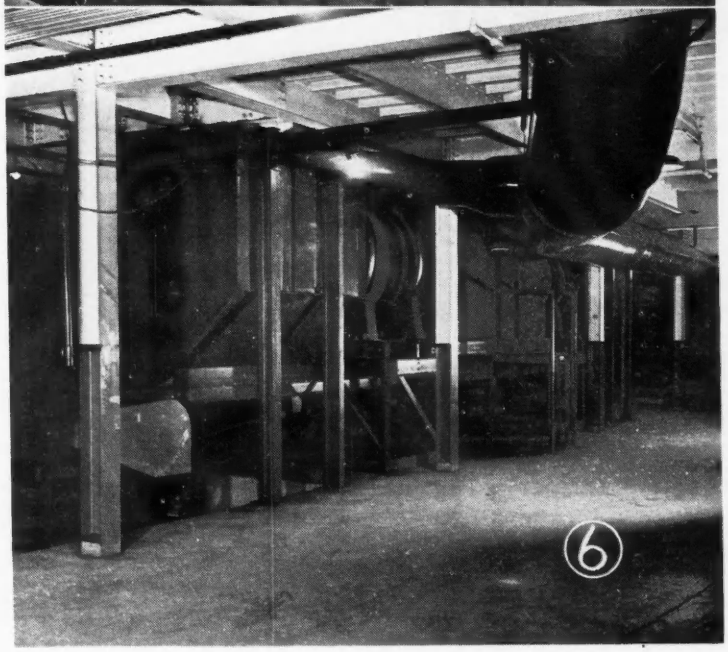


4—General view showing part of the large battery of Lindberg, square, pit-type furnaces used for heat treating and aging of cylinder heads.

5—Perspective in sand storage bay, with Link-Belt oil-fired rotary kiln, center left, and the Link-Belt rotary louvered shell below for drying the sand. This installation produces the reclaimed facing sand.



6—View in basement gallery—part of large C. O. Bartlett & Snow sand reclaiming installation.

A New Development in

Two-Stroke D

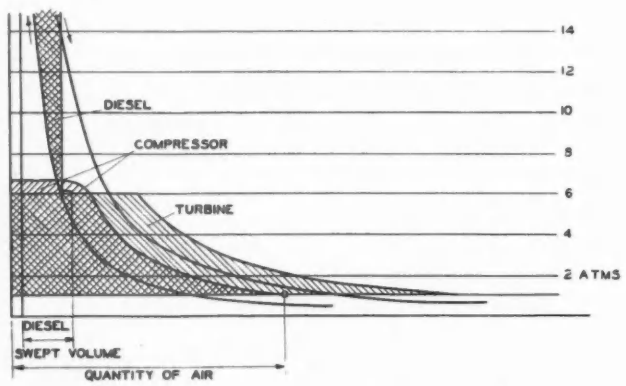


Fig. 1—Lower part of the indicator diagram of a two-stroke Diesel engine supercharged to 6 atm. abs.

SUPERCHARGING of two-stroke Diesel engines is an old practice, and is now common in all such engines except those with crankcase scavenging. But in the past the charging pressure generally has been kept quite moderate, usually at between 5 and 8 psi gage. If higher charging pressures are used, not only is an unduly large proportion of the engine power required to drive the blower, but a considerable proportion of the heat energy of the fuel is wasted in the exhaust, the pressure and temperature of which increase with the charging pressure. A simple solution of this problem would seem to be to use a turbo-compressor as a supercharger, but, unfortunately, the conventional turbo-blower is not applicable to two-stroke engines, because it does not provide for starting. In these engines there is no separate induction stroke, and the charge must be forced or pumped into the engine cylinders by outside means under all operating conditions. As there is no exhaust gas to operate the blower when the engine is being started, the turbo-blower cannot perform the scavenging and charging functions during the starting period.

The problem of increasing the specific power of two-stroke Diesel engines has been studied by the firm of Sulzer Brothers of Winterthur, Switzerland, and its engineering staff has worked out a number of schemes permitting of the use of high supercharge ratios with such engines and of the recovery of part of the heat energy in the exhaust by means of a gas turbine. One of these provides for the combination of a reciprocating type of compressor with the engine on the same bedplate, which furnishes all of the air necessary for scavenging and charging. The exhaust gases are delivered to a gas turbine which is in driving connection with the crankshaft. Instead of a reciprocating compressor, a rotary blower may be used, driven from the engine crankshaft, and the gas turbine, instead of being placed in direct driving connection with the engine crankshaft, may then be connected to the blower.

Sulzer Brothers point out in this connection that while the four-stroke engine also may be supercharged in a high ratio, the two-stroke always will have the advantage with respect to specific output, because with it the frequency of power strokes is relatively twice as great.

The proportion of the horse power available at the crankshaft of the Diesel engine which is required to

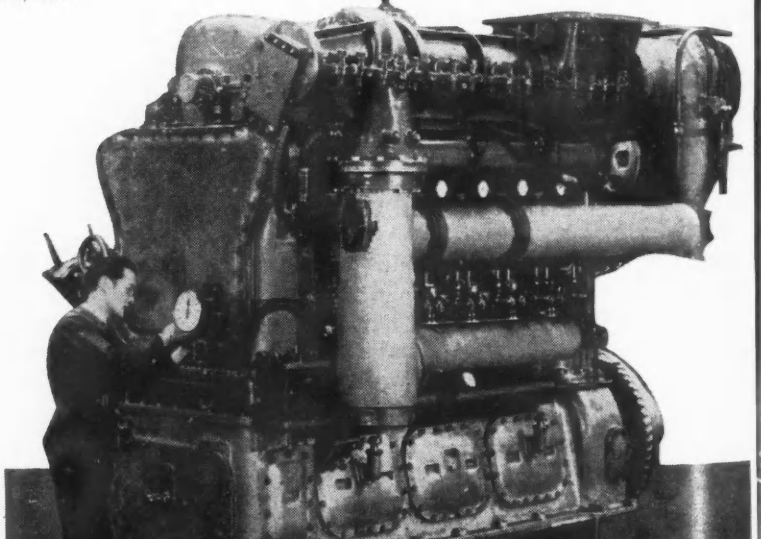


Fig. 2—Sulzer six-cylinder opposed-piston-type two-stroke Diesel engine with a one-hour rating of 1560 bhp at 850 rpm.

Diesels

drive the blower increases with the charging pressure. With a non-supercharged engine, where the blower merely furnishes scavenging air, it consumes about 6 per cent of the engine horse power. Charging at one-and-one-half atmospheres (7½ psi supercharge) requires about 16 per cent of the engine power for the blower; charging at two atmospheres (15 psi supercharge) requires about 25 per cent of the power for the blower, and if the engine is charged at between five and six atmospheres, all of the power generated in its cylinders is required to drive the blower. But as the charging pressure increases, the power available in the exhaust also increases, and the turbine becomes an important source of power. If all of the engine power is used to drive the blower (with a charging pressure of 5 to 6 atmospheres) the turbine is the only source of power for doing external work, and there is therefore no need for connecting it up to the crankshaft of the engine. The engine then serves only as a source of working medium for the gas turbine; it becomes a gas generator, and what is usually referred to as the exhaust is more properly called power gas.

If an engine, instead of being charged at atmospheric pressure, is charged at several times that pressure, it need not be nearly as large to pass air at a certain rate and develop a certain power. However, a constant excess air ratio cannot be maintained, as it would lead to excessive heat stresses in continued full-load operation. The proportion of the maximum amount of fuel injected to the air charge will have to be reduced when a high supercharge ratio is used, and this will somewhat reduce the proportion in which the engine displacement can be decreased under such conditions. On the other hand, the smaller engine can be operated at a higher speed of revolution, which permits of a further reduction in displacement.

Sizes and power relationships for an engine supercharged to six atmospheres can be studied by means of the diagrams shown in Fig. 1. The quantity of air passed per cycle is plotted along the base line, as is also the swept volume (or piston displacement) required. For a given rate of air flow, if the displacement of a non-supercharged engine is made equal to 100, that of an engine supercharged to two atmospheres is approximately 61 and that of the engine supercharged to six atmospheres, approximately 26.

A number of experimental engines to test out the system have been built by the Sulzer firm. At first a plain two-stroke Diesel engine without compressor and without exhaust turbine was experimented with, the charging air being taken from the compressed air system of the plant and heated, and the effect of the turbine on engine operation simulated by means of a throttling orifice in the exhaust passage. With this engine it was possible to obtain an mep of 170 psi with clear exhaust. With another engine tested under the same conditions later on, an mep of 185 psi was obtained and maintained for 48 hr.

Next the same experimental engine was operated with a charging pressure of three atmospheres (44 psi abs.), which permitted an mep of 210 psi to be maintained with a clear exhaust. It will be seen from the figures given that the meps do not increase in direct proportion to the charging pressure, as the change from 1 to 2 atmospheres gives an increase of about 85 psi in the mep, while an increase from two to three atmospheres charging pressure raised the mep only 40 psi. This is due to the fact that at the higher supercharge ratios the proportional fuel charge is decreased to limit the heat stresses.

Sulzer Brothers next built an engine specially designed to operate with a high supercharge ratio and intended for traction and similar purposes. It is of the horizontal double-piston type and has four cylinders of a bore of very nearly 7½ in. and a stroke of nearly 12 in. for each piston. The exhaust turbine is overhung on the exhaust manifold and its output is

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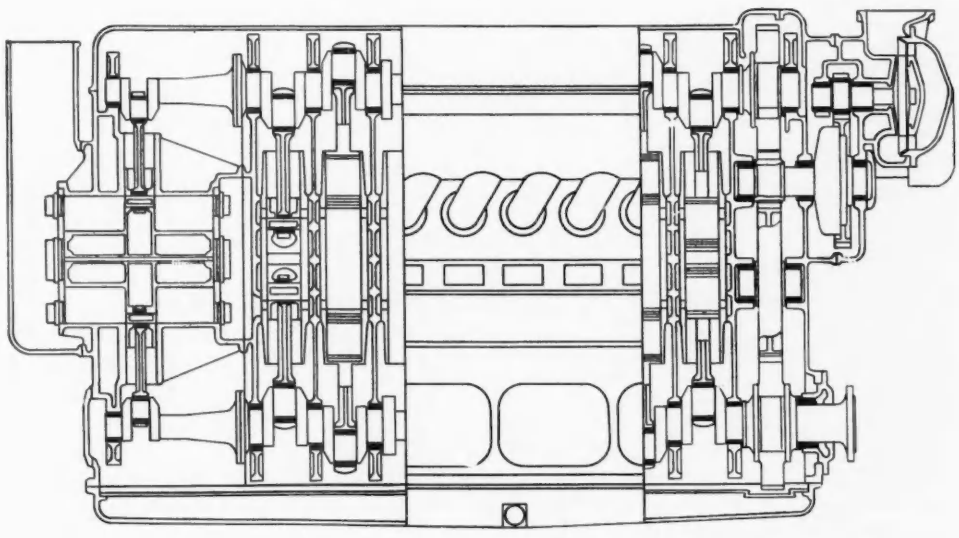


Fig. 3—Part-sectional elevation of Sulzer eight-cylinder, opposed-piston type two-stroke Diesel engine rated 2750 hp at 1000 rpm.

Electronic V

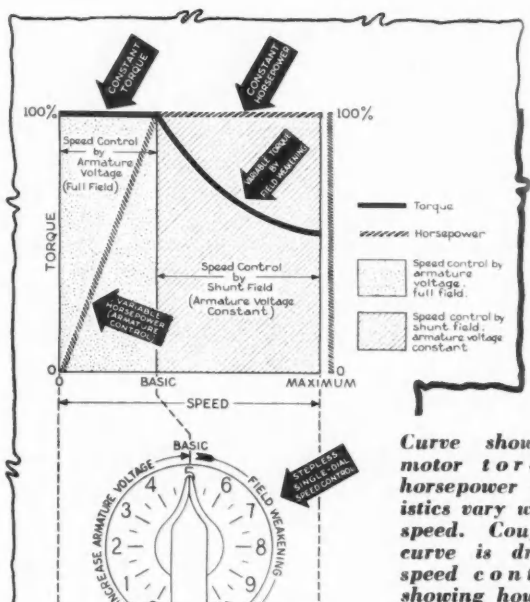
By S. D. Fendley

Electronic Section Industrial Control
Division General Electric Co.

THE experience and knowledge obtained from the use of thyratron-tube motor control for more than a decade have made possible the development by General Electric of a new electronic variable-speed drive with features and characteristics that make it ideally suited to a variety of industrial applications. The versatility of this new drive, which has already been applied extensively, is provided by a new adjustable-voltage electronic control system, called Thy-mo-trol.

The primary function of practically all of the earlier electronic motor controls has been to adjust the speed of the motor. The other requirements such as starting, accelerating, etc., have been obtained largely through the use of various combinations of conventional control devices. Now in service are a relatively large number of these thyratron motor-speed controls. Generally speaking, these consist of an adjustable-voltage rectifier using thyratron tubes to supply the d-c for the field and armature of the motor. By varying the output voltage of the tubes the speed of the motor can be changed. Some type of feed-back system is employed to do this, either of mechanical or electrical type.

The standard Thy-mo-trol drive consists of an anode transformer, a control and rectifier panel, a push-button station or other control accessory, and a d-c driving motor. In some instances, a smoothing reactor may also be required, depending upon the size and characteristics of the motor being used. The transformer is of conventional design and may be either of the insulating or of the autotransformer type. It is generally supplied as a separate item to keep to a minimum the size, weight and cost of the rectifier cabinet in which it might otherwise be located.



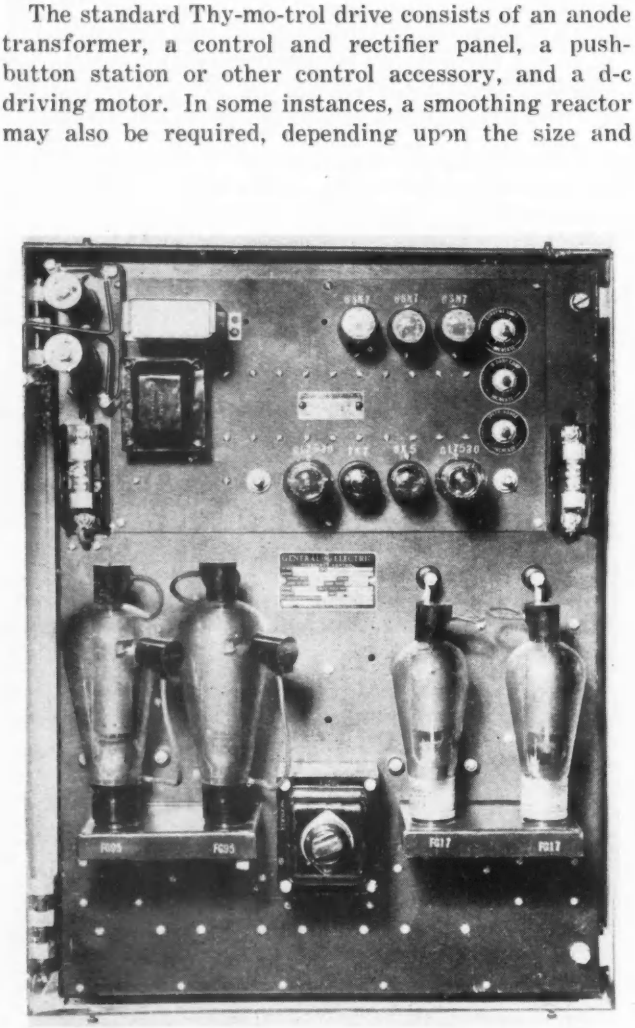
Curve showing how motor torque and horsepower characteristics vary with motor speed. Coupled with curve is drawing of speed control dial showing how speed is controlled in the armature and field ranges by a single dial.

A conventional Thy-mo-trol control panel is shown here. It consists of a suitable base on which are assembled the control and power tubes, a line contactor, a thermal overload relay, a field-failure relay, a cathode-protective timer and the necessary transformers, and other material required for the electronic circuit. Suitable anode fuses are provided for protection against short circuits. The control accessory is a standard heavy-duty-type push-button station in which are mounted the necessary number of momentary contact units and the speed-adjusting potentiometer. Both the speed-adjusting potentiometer and the momentary control units may be supplied as separate items which the user can mount in any convenient location.

A shunt-wound d-c motor is used and in order to make more economical use of the rectifier tubes, 230-volt machines are ordinarily supplied.

Acceleration

One of the characteristics of a good drive is that



(Left) Thy-mo-trol heavy-duty-type push-button station.

Variable Speed Drive

it should be capable of starting its load with a minimum of shock to the machine and under conditions which will permit the motor to commutate satisfactorily. From an engineering point of view, the accelerating scheme employed in this drive is said to approach this ideal. It is termed constant-current limit acceleration. By means of an adjustment in the panel, it is possible to vary the accelerating current and thus the accelerating torque to a value which will bring the motor up to operating speed in the quickest time consistent with the nature of the load and the commutating ability of the motor.

From the moment the start button is pressed, the motor will assume a maximum value of current as determined by the adjustment. Under these conditions the motor will pull with smooth, uniform torque until the load is up to speed; then the current will drop off to the value needed to maintain the required torque.

For many applications, it is desirable to preset the speed at which the motor is to operate anywhere within the operating range. This type of equipment provides this feature so that the motor will be accelerated smoothly up to the speed called for by the setting of the potentiometer. The motor is always started under full-field conditions regardless of whether the potentiometer is set for operation below base speed by armature voltage control or above base speed in the field weakening range.

Quick stopping of the motor is provided by means of conventional dynamic braking. When the STOP button is pressed, the power is disconnected and a resistor is connected across the armature.

Speed-range

The speed-range obtainable with equipment of this type is largely a function of the size and type of motor employed. From tests which have been made it appears that the motors can be operated over a range of up to 20 to 1 below base speed by armature control on an intermittent basis without exceeding a dangerous temperature rise, and as high by field control as the motor is designed to operate.

By providing closely regulated armature voltage and automatic compensation for R.I. drop, this system holds the motor speed constant within close limits, independent of load and ordinary line-voltage variations. An adjustment in the panel makes it possible to adjust the regulation to provide a drooping speed characteristic where this is desirable.

For a given speed setting, the equipment can be adjusted to hold the regulation to a value of approximately 2 per cent variation from no load to full load when operating below the basic motor speed. When the motor is operating in the field weakening range, the speed will decrease with load, to a value not exceeding 10 per cent depending upon the rating of the drive.

For applications where a more precise speed regulation is desired than that obtained with standard equipment, it is possible to use the output voltage of a tachometer generator in the circuit and obtain a speed regulation on the order of plus or minus ½ per cent from no load to full load.

The system will operate successfully on line-voltage variations of as much as 10 per cent of rated voltage, but to obtain maximum tube life the variation should not exceed plus or minus 5 per cent.

When the motor is operating at speeds below basic, during which it has full-field voltage and reduced-armature voltage, it will provide constant torque. The horsepower output will decrease in proportion to the decrease in speed. When operating at speeds above

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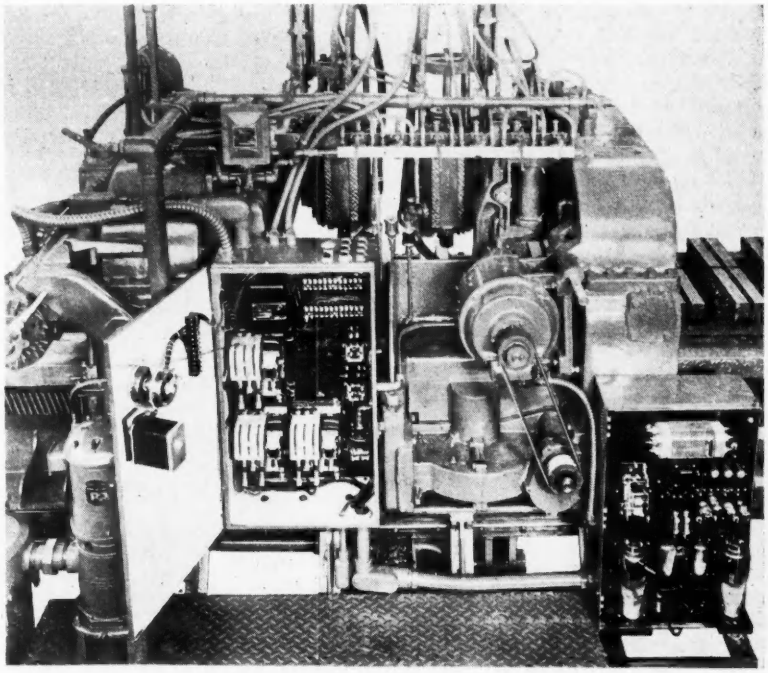
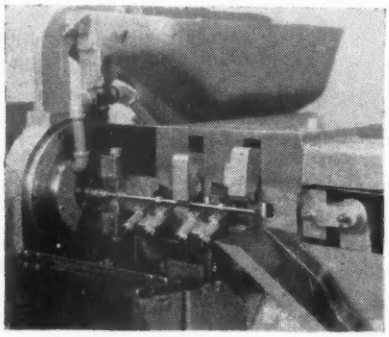


Standard Thy-mo-trol panel (lower right) mounted on machine for milling airplane spars. Electronic control on this machine is used to control the d-c feed motor. The a-c magnetic control panel (left center) controls other operations.

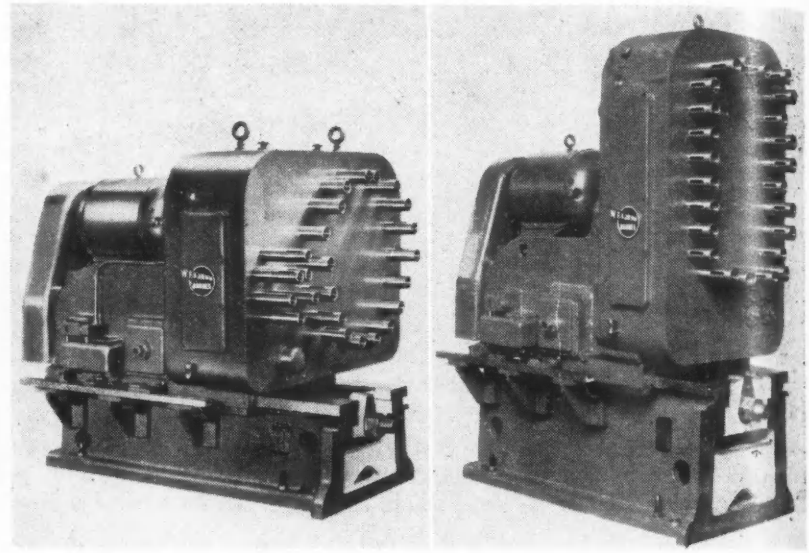
New Production

THE automatic straight tap nut tapping machines manufactured by the Waterbury - Farrell Foundry and Machine Company, Waterbury, Conn., have been redesigned and improved recently by the addition of several new features. The hopper feed mechanism has been improved and a selector mechanism provided which will handle special pieces, such as castle nuts, and deliver them to the tap so they all face the same way. The pusher mechanism which advances each nut into the work holding jaws, is entirely new. The feed cam and change gears are located within a casing and are easily replaced after removing a cover plate which is held in place by two latches. The pusher is arranged so that it can be easily withdrawn from the chute end when necessary to clear any obstructions. The tap holding and nut stripping mechanism has been redesigned. The tap is held in place by two pairs of clamping arms which open and close alternately, allowing the tapped nuts to be intermittently pushed along the tap shank by a pair of vertical spring fingers and two horizontal claws which are assembled in, and actuated by, a horizontally reciprocating slide.



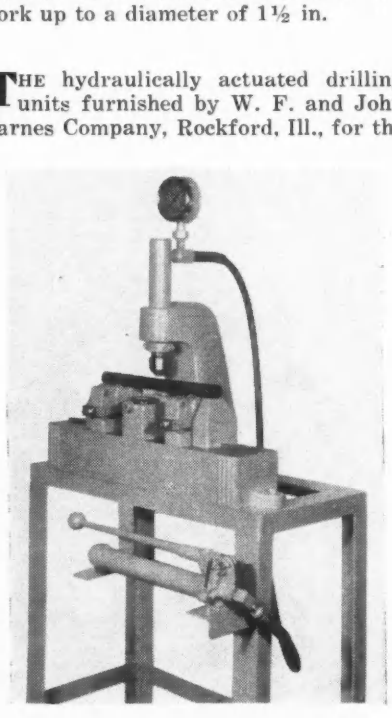
Waterbury-Farrell Nut Tapping Machine.

THE Model HP-010 hydraulic hand press, a straightening press designed to eliminate moving work from anvils to centers for checking, is being offered by Anderson Bros. Mfg. Co., Rockford, Ill. Checking and bending are done in the same position; when pressure is released, the spring tension on rolls brings the shaft free of the anvils and free to rotate for checking. Checking rolls are adjustable for different lengths of shafts, and may be removed altogether if necessary. The press is equipped with an indicator gage calibrated in thousandths of an inch for locating high and low spots on shaft, and with a pressure gage calibrated in pounds. The machine is built to handle work up to a diameter of 1½ in.



W. F. and John Barnes Standard Hydraulically Actuated Units for Drilling Revolving Turret on M-4 Tanks.

THE hydraulically actuated drilling units furnished by W. F. and John Barnes Company, Rockford, Ill., for the drilling of the 360 deg revolving turret on the M-4 medium tank, are of their standard design equipped with special multi-spindle heads. One unit has 25 spindles and the other has 24 spindles. The spindles on the 24-spindle head are arranged with 18 of them equally spaced about a circle and 6 in a cluster. Both heads are equipped with anti-friction bearings, hardened alloy steel gears, and heat-treated spindles and shafts.

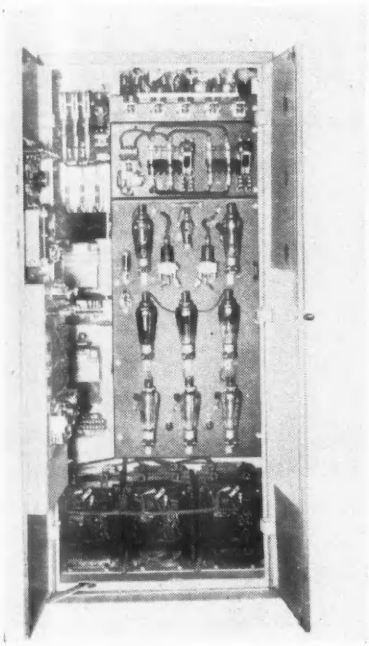


Anderson Model HP-010 Hand Hydraulic Press.

SIMPLIFIED construction is one of the features which characterize a new electronic capacitor discharge resistance welding control announced by the General Electric Company, Schenectady, N. Y., for the resistance welding of aluminum. Employing the energy-storage principle, the new control is said to effectively perform all the functions for which a control of this type is designed. Aluminum has low resistance and high heat conductivity. This control provides the very high currents and short welding time required for the satisfactory resistance welding of this metal.

The control consists of a charging circuit, a discharge circuit, control station, Pyranol capacitors, and sequence control. All this equipment is mounted in one cabinet-type, G-E industrial control enclosure with full-length front doors and removable rear covers. The enclosure is ventilated by filtered air

Equipment



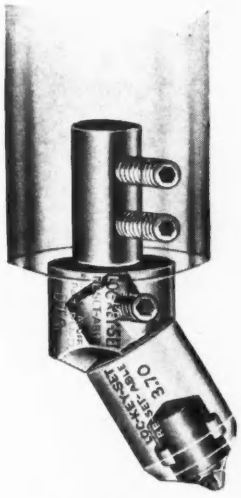
General Electric Electronic Control Panel for Resistance Welding of Aluminum.

which, drawn in by a blower, creates a positive pressure within the cabinet and so minimizes the infiltration of dust and dirt. The main anode transformer and all tubes requiring cooling are air-cooled by a ductless system.

An example of this control's simplified construction is the position of the charging- and discharge-tube circuits. These are mounted on a single, hinged compound base that can be swung out readily for servicing. Another feature is the fact that the control station, consisting of the capacitor selector switch, voltage adjusting potentiometer, sequence adjusters, voltmeter, control switches, and indicating lights, can be removed from the cabinet and attached to the welding machine. With this arrangement, the control cabinet can be located on a balcony or some other remote point, thus conserving valuable factory space.

Jackson Model F-1 Welding Electrode Holder.

AN IMPROVED Angle-Set tool for diamond dressers, used in centerless grinding of bullet noses, is announced by the Diamond Tool Company, Chicago, Ill. This 30 deg side angle lock set holder enables bullet nose grinders, using centerless grinders with the template attachment, to use common quality diamonds to form wheels by dressing from 1 in. to 6 in. radius with the Angle-Set. The mean fixed position, left or right, in which the diamond nib is held, is said to prevent wear to the setting in this operation and to eliminate the use of thin diamonds and weak points for dressing. The tool permits rotation of the nib to re-sharpen the diamond.

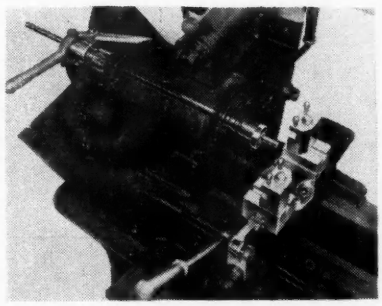


Improved Angle-Set Tool for Diamond Dressers.

A LIGHT, slender welding electrode holder designed especially for welding in the aviation, automotive, motor service and allied fields has been introduced by Jackson Products, Detroit, Mich. The holder, Model F-1, is made of special high conductivity copper alloy, has a rated capacity of 200 amps., and takes rods from the smallest up to 3/16 in. It has an overall length of 7⅞ in., weighs 12 oz. and has mechanical or solder cable connection.

The holder is insulated to prevent damage which might otherwise result from contact with the work. Its light weight and slim proportions are said to enable the welder to manipulate it easily in tight places.

TWO accessories for use on small and medium size engine lathes are now in production at the Kessler Aero Products Company, Burbank, Cal. The Aero quick-acting collet closing attachment handles bar and tubing stock from 1/32 in. up to ½ in. diameter. It chucks or releases work while the lathe is running. The Aero lever-type cross slide used in connection with the collet closer provides for forming and fast cut-off. Both attachments, which may be assembled without machine work, are said to be suitable for use with Atlas, South Bend, Logan and similar lathes having a spindle hole of ¾ in. capacity.



Aero Quick-Acting Collet Closing Attachment and Lever-Type Cross Slide assembled on lathe.

THE Johnson metal cut-off band saw, made by the Johnson Manufacturing Corporation, Albion, Mich., will handle round stock up to 10 in. or flat stock up to 18 in. It is supported on

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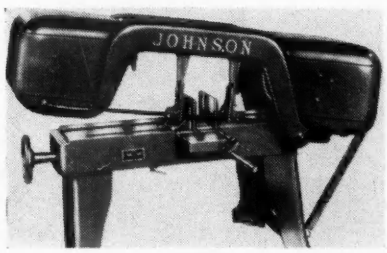
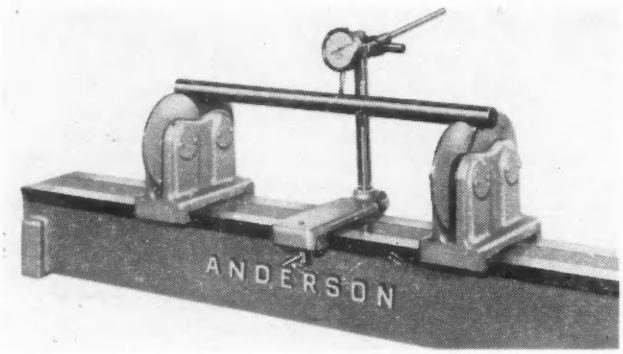


The Johnson Metal Cutting Band Saw.

three legs, eliminating torsional strain due to uneven floors. The built-in hydraulic control is said to give correct constant feed for every type of stock and to be readily disassembled. Band wheels, 16 in. in diameter, are mounted on welded steel brackets which are bolted high in the box-type frame. The machine is driven by a half-horsepower ball bearing motor, and speeds of approximately 35, 90, 130 and 190 fpm are provided.

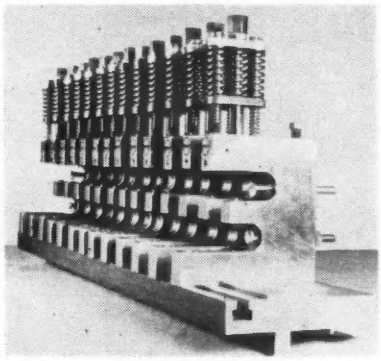


Anderson Roto-Checker.

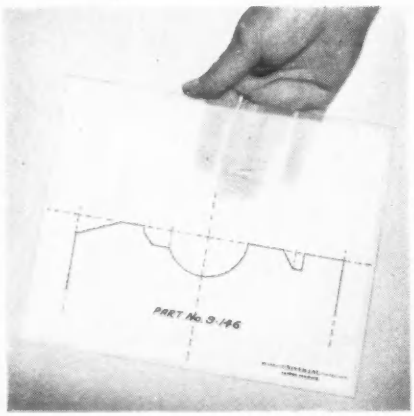
THE Anderson Roto-Checker has been developed by Anderson Bros., Rockford, Ill., for checking shafting, tubing, or other round pieces which have the same diameter at both ends. The work to be tested is placed directly on the discs which rotate on ball bearings.

The Roto-Checker also provides for static balancing, as the spindles and bearings are the same standard parts that are used in Anderson balancing equipment. The standard unit will handle work 36 in. long; larger sizes will be made to special order.

WALES Type "E" hole punching units, a new development of The Strippit Corporation, North Tonawanda, N. Y., are designed for punching a series of holes simultaneously in shapes on press brakes. The center projection, carrying the die member, extends into all shapes of extruded work, and provides clearance for the legs in the lower gap. Each Wales Unit is made up of punch, die, holder, stripping spring and guide; nothing is attached to the ram of the press. The punch and die are held permanently in alinement, and by tightening one bolt, the unit is locked into position on the rail. The flexibility of positioning makes possible the use of a template as a guide for quick pattern set-ups.



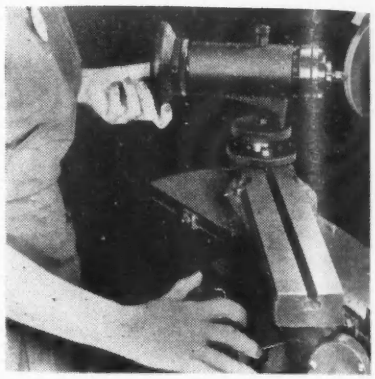
Wales Type "E" Units for punching "H" section stock.



Translucent Engineer's-Glass with Inked-in Diagram.

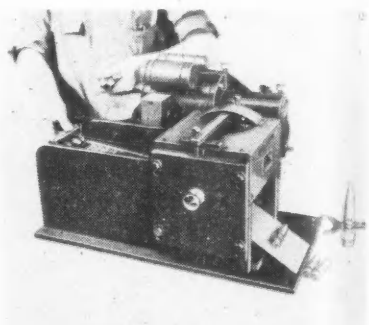
TRANSLUCENT Engineer's-Glass is a thin-vellum drawing paper cemented to one surface of smooth-edged, ⅛ in. thick plate glass. It is somewhat less translucent than ground glass, and is said, by the makers, The Universal Engraving & Colorplate Co., Buffalo, N. Y., to have an excellent surface on which to draw with pencil or pen. Diagrams drawn on it can be placed directly on the viewing screens of comparators and other micro and contour projectors and checked for accuracy, or employed as charts temporarily. The prime purpose of these diagrams is for their reproduction in the form of permanent charts which are called Engineer's-Transparencies. These are durable images on plate glass; duplicates of the diagrams drawn on Engineer's-Glass. Drawings on Translucent Engineer's-Glass are returned to The Universal Engraving & Colorplate Co. to be duplicated on Engineer's-Transparencies.

THE I-G-C relief grinding fixture, for use with any standard grinder, has been brought out by the Industrial Grinding Co., Los Angeles, Cal. It will handle countersinks of all types, center drills, integral pilot cutters and pilot drills. Standard collets are available to handle work from 1/16 in. to 1 in. diameter. The lift of the single cam is variable from .001 in. to ⅛ in. and adjustment pins are provided for 1, 2, 3, 4, 6 and 12 fluted cutter grinding. The cam is hardened tool steel, with steel adjustment pins.

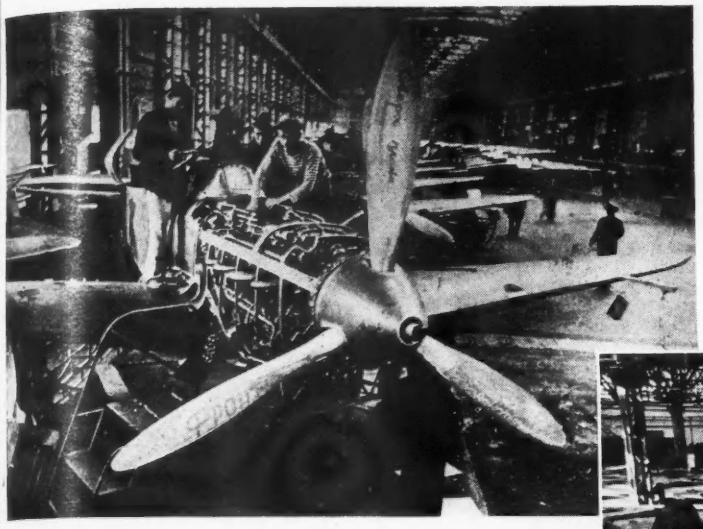


The I-G-C Relief Grinding Fixture

THE Acromark Company, Elizabeth, N. J., is producing a new Model 12B marking unit. This machine is for production work in die-marking shells, shot, tags, tubes, bushings and other items of copper, brass or unhardened steel. It puts indentification numbers, code stamps or other marking up to four lines of type or their equivalent, in ⅛ in. letters, and die-cuts these marks on the product. Adjustment is provided for marking products of various sizes, and feed is automatic from a chute to the die.

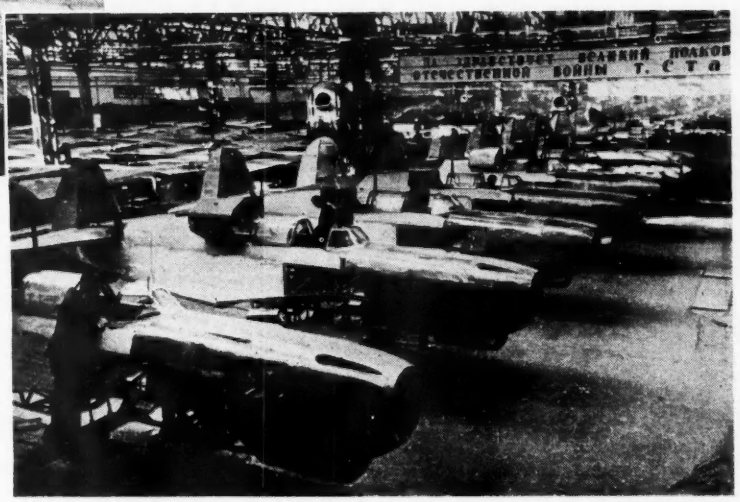


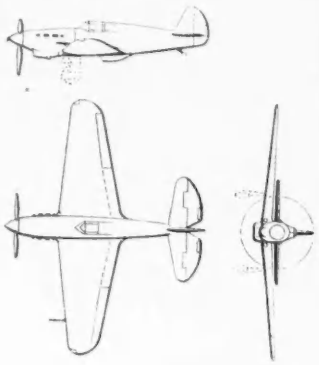
No. 12B Acromark Shell, or Cylinder Marking Machine.



(Left) Close-up view of a YAK-1 plane on the final assembly line.

(Below) The YAK-1 fuselage assembly line.



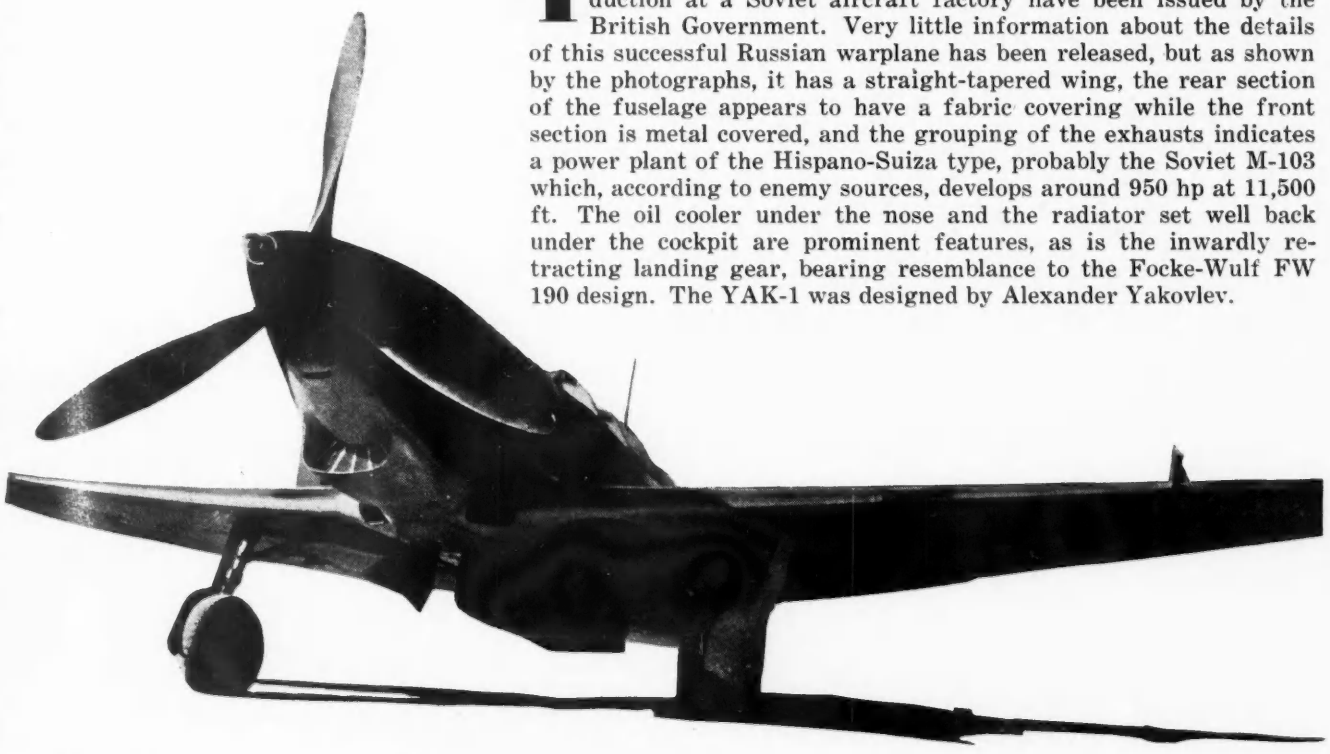


General arrangement of the YAK-1 (I-26).

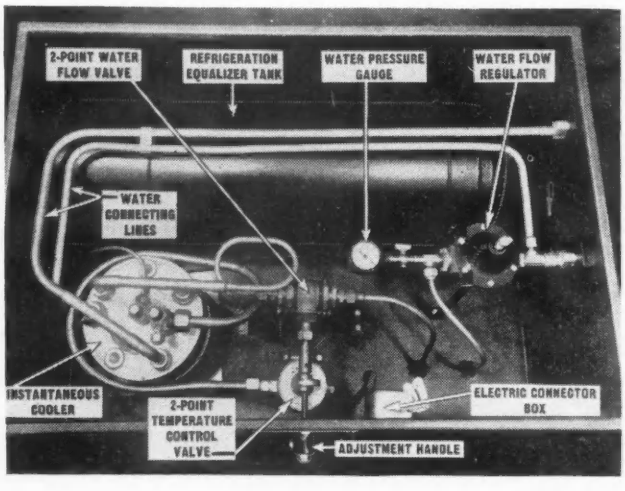
YAK-1 (I-26) Fighters

on the Assembly Line

THESE U.S.S.R. official photographs of the YAK-1 (I-26) in production at a Soviet aircraft factory have been issued by the British Government. Very little information about the details of this successful Russian warplane has been released, but as shown by the photographs, it has a straight-tapered wing, the rear section of the fuselage appears to have a fabric covering while the front section is metal covered, and the grouping of the exhausts indicates a power plant of the Hispano-Suiza type, probably the Soviet M-103 which, according to enemy sources, develops around 950 hp at 11,500 ft. The oil cooler under the nose and the radiator set well back under the cockpit are prominent features, as is the inwardly retracting landing gear, bearing resemblance to the Focke-Wulf FW 190 design. The YAK-1 was designed by Alexander Yakovlev.



New Products



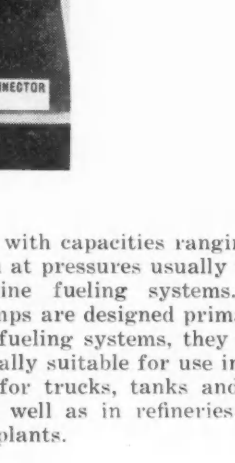
The Temprite Model 555-PD Refrigerating Unit.

New Model Temprite Refrigerating Unit

The model 555-PD refrigerating unit, now being marketed by Temprite Products Corp., Detroit, Mich., is designed to circulate large quantities of controlled temperature water around the processing solution containers in X-ray film development tanks. In addition to supplying water at 65 deg F for controlling the temperature of the developing solution, the unit makes available large quantities of clean controlled temperature water for washing film or plates, as all water used is drained off and not recirculated. A feature of this model is the circulation of waste water around the fresh water inlet coil, which pre-cools the incoming water and makes possible the use of smaller refrigeration equipment on high capacity installations.

Turbine Type Pumps For Fueling Systems

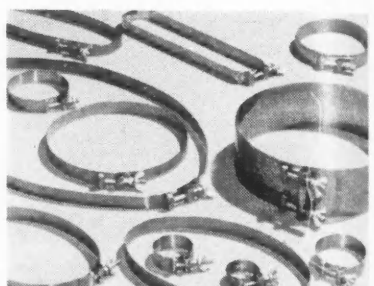
The Deming Company, Salem, Ohio, has developed a line of gasoline and fuel oil pumps, of the turbine type, especially for aviation fueling systems. For this purpose, the pumps are usually mounted directly on storage tanks located underground. A number of units may be used to supply different grades of fuel to truck loading stands, although a single pump can easily take care of several dispensing outlets located at convenient points around the service area. Various size pumps are available with capacities ranging up to 1000 gpm at pressures usually required on gasoline fueling systems. While these pumps are designed primarily for aviation fueling systems, they are said to be equally suitable for use in fueling stations for trucks, tanks and marine craft, as well as in refineries and industrial plants.



The Deming Gasoline and Fuel Oil Turbine Pump.

Clamp for Hose And Duct Lines

New type air and oil duct clamps, introduced by Marman Products Co., Inglewood, Cal., are especially built for hot or cold installations for aircraft, automotive, tank or marine engines and assemblies. They are made in a number of sizes from 1⅜ in. to 38 in. and are said to conform to any convex surface, whether square, oblong, circular or triangular. The design permits the clamp to be quickly wrapped around the hose and duct section and tightened with one hand.



New Marman Air and Oil Duct Clamps.

Low Expansion Alloy Made Free-Machining

A free-machining alloy, known as Carpenter Free-Cut Invar "36," is now in commercial production at The Carpenter Steel Company, Reading, Pa. This newly developed alloy is said to have exactly the same low expansion properties as the regular grade Invar which is very difficult to machine. The addition of selenium to the alloy gives it the free cutting properties without altering its thermal expansion characteristics. Where precision parts with low thermal expansion properties must be machined in large quantities, its free-machining qualities will help to increase output per man-hour.

Willow Run Production Up to Schedule but Not Up to Capacity

Manpower and Design Change Problems Must Be Solved to Attain Volume Production

Manpower and design changes are the two major problems that must be solved before the Willow Run bomber plant of the Ford Motor Co. attains volume production of B-24 four-engine bombers. The labor shortage at the huge plant, now employing more than 30,000 workers, is accentuated by an acute housing shortage within a 10-mile radius, the transportation problem and the severe winter weather that Michigan has experienced. Design changes, dictated by combat experience of the Army Air Forces, have come through at the rate of hundreds a week and present a difficult problem in maintaining continuous assembly operations with comparatively inexperienced personnel. So far the material flow has been adequate for manufacturing operations.

Output of finished bombers is a military secret but the Office of War Information recently announced that "Willow Run, while meeting the present War Dept. schedule, is running at only a small fraction of its ultimate potential. This schedule has been frequently revised. . . . Peak production may be attained within a year. Despite increasing production, the original program was slow in getting under way. The first completed bomber to be assembled on Willow Run production lines was not completed until three months after the date set in the company's plant. The first assembly was even more behind schedule."

"Production at Willow Run," the OWI report continued, "is divided between completed planes and sub-assemblies. The sub-assemblies require the major portion of the man-hours necessary to produce a complete plane. The sub-assemblies are shipped to aircraft plants elsewhere for final assembly. In November and December no sub-assemblies were shipped. Instead, they were made into completed bombers at Willow Run to give the Willow Run employes added experience and training. Shipment of sub-assemblies was resumed in January."

A recent revision of government schedules will require that a greater percentage of Willow Run production be completed bombers and a smaller percentage sub-assemblies for shipment elsewhere. It also will revise peak employment estimates upward by some 40 per cent. Previous peak had been regarded as 50,000 workers. More than 50 huge trailers, each of them over 60 feet long, are engaged in hauling sub-assemblies to the Southwest. Two trailers carry the sub-assemblies for a complete bomber.

Not Bad, Says Truman Committee

"There is no question that production has been handicapped by constant changes in model. But there has been a vast improvement at Willow Run over what we saw here a year ago. Willow Run compares very favorably with any plant in the country on ac-actual work being done." — Senator Wallgren, of Truman Committee, after visit by Subcommittee to Willow Run.

On the subject of tooling the vast plant, which required 13,000 mechanical dies, the OWI report said, "The comparatively permanent and inflexible methods of tooling used at Willow Run have taken longer than was expected to complete. The theory behind Willow Run was that the size of the plant and the permanency of the tooling would require a much greater time to complete than would a smaller plant using the aircraft industry's more flexible tooling methods. The Ford engineers

(*Turn to page 44, please*)

Additional Equipment For Five War Plants

Chrysler Corp. has received an increase in a contract with the Defense Plant Corp. for additional equipment for a plant in Michigan, bringing the total commitment to $800,000. Goodyear Aircraft Corp. has had a DPC contract boosted by $2,140,000 for additional plant facilities in Ohio, increasing the total to $3,600,000. Burd Piston Ring Co., Rockford, Ill., has been granted a contract for approximately $190,000 to equip a plant in Illinois.

Buffalo Arms Corp., a subsidiary of Houdaille-Hershey Corp., has been awarded a $673,000 increase in its DPC contract for additional equipment for a plant in New York State, the overall commitment now being approximately $15,000,000. Intercontinent Aircraft Corp., Miami, Fla., has been authorized to increase its contract for plant facilities in Florida, the new total being approximately $2,047,000.

The American M7 tank destroyer which is being used by the British forces under General Montgomery. It carries a 105 mm. howitzer and a .50 caliber machine gun.

International News Photo

Labor Trouble in Soft Coal Mines May Reduce Steel Output

Severe Weather Slows Down Scrap Collection, May Also Retard Ore Shipments on Lakes

By W. C. Hirsch

Overshadowing all other of the many vexations, that are the lot of both steel producers and consumers these days, is steadily growing apprehension over the outcome of negotiations regarding union demands for a $2 per day increase in the bituminous coal miners' wage scale. Ordinarily the issue raised would simmer down to how much, if anything, would be added to the coke cost of blast furnaces and foundries. The possibility of much more extensive harm at this time is seen by many. If a strike is averted through any sort of a compromise, steel price ceilings may have to be adjusted, if producers are not to be penalized. If a strike ensues, even if it is speedily terminated by orders of the President, disaffection may spread to the steel industry crafts. In any event the rate of production is likely to suffer, and while output in recent weeks has been very satisfactory, the war program can not be carried out, if there is even a shortlived interruption of the present pace.

The success of the plan of Vice-Chairman Charles E. Wilson of WPB, to give prompt consideration to requests by war equipment contractors for allocation of "critical common components" in the first half of 1943 is predicated on a continued flow of basic ferrous material to finishing mills at the present rate, and any pause in coke output would make itself painfully felt in carrying out this program. Anxiety on this score, while chiefly caused by the disturbing outlook in the soft coal industry, stems to a lesser degree from the possible inroads on the movement of scrap iron as a result of severe winter weather, which may also retard the reopening of lake navigation and thereby impair 1943 ore receipts.

According to an American Iron & Steel Institute release, alloy steel demand is running at a rate exceeding one out of every six tons of steel produced. During World War No. 1 the proportion was about one ton of alloy steel for every 25 tons of steel produced. The Institute also disclosed that from 1941 through 1943 the American steel industry has spent or prepared to spend $773,000,000 of its own funds to increase capacity and improve equipment. In the pre-War period of 1938 to 1940, its expenditures for this purpose amounted to $432,000,000, making a total for the approximately five-year period of $1,205,000,000. About 30 per cent of the money went for additions to blast furnace capacity and 15 per cent for increasing rolling mill facilities. When the program has been completed, electric furnace capacity will be three and a half times what it was five years ago.

Recent discovery of an important vanadium ore bed in Idaho and Wyoming, promising a yield of many millions of tons of ore, is reported by the United States Geological Survey. Vanadium is used to toughen armor plate and many other kinds of steel that serve in war equipment.

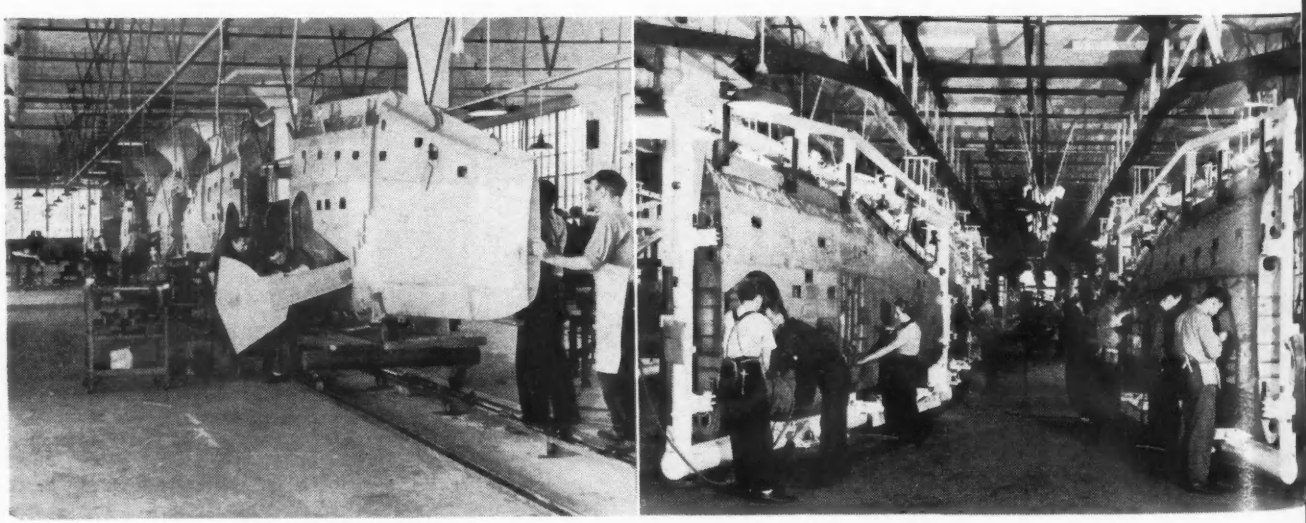
According to a statement by the Belgian Minister of Colonies, tin production in the Belgian Congo has now attained a tonnage, which may soon overtake the output of Bolivia. For some years the South American country was the second largest tin producer, its output being exceeded only by that of Malaya.

Chevrolet and Buick Expand

Two divisions of General Motors Corp. making Pratt & Whitney 1250 hp aircraft engines—Buick and Chevrolet—have had their 1943 manufacturing schedules greatly increased. Buick will triple its output of bomber engines at Melrose Park, Ill., and at Flint, according to H. H. Curtice, General Motors vice-president and general manager at Buick. Chevrolet will increase five fold its current rate of production, according to M. E. Coyle, General Motors vice-president and general manager at Chevrolet.

Chevrolet is both a prime contractor on the complete engine and a subcontractor on engine parts, supplying many major aircraft engine manufacturers with parts in volume. It also is a large producer of aluminum forgings for aircraft, a newly acquired plant at Anderson, Ind., augmenting new facilities already in production at Saginaw. The major engine assembly is at North Tonawanda, N. Y.

Buick is producing approximately 50 per cent of the aircraft engine at Flint. The balance of the machining, final assembly and testing takes place at Melrose Park.



Power Driven Assembly Line Applied to Aircraft Fabrication

A unique feature of the assembly system at the Murray Corporation is the use of moving jigs suspended from overhead conveyors. These jigs, which hold the product, travel in a steady stream from workman to workman, until all parts are installed and the subassemblies are riveted into the complete wing. Through this system, it is possible to train production workers in single skills rather than the full cycle of operations required when material is positioned in conventional jigs and fixtures. Until overhead conveyors were put into use, it was necessary to do all riveting and assembly work in flat jigs to prevent the wings from getting out of plumb.

Apostle of the *Impossible!*

He's a strange sort of genius compounded of curiosity, skilled hands and a peculiar mental twist . . . He has visions of impossible things.

One day recently, the National Inventors Council in Washington — America's clearing house for war-winning inventions — had a letter from him. It read: "Sirs: I've a couple of ideas in my head that may be of military importance. Kindly send me your bulletin so that I'll know what to do to help. Yours for Victory!"

And today, one of those ideas is helping to win the war — literally "Yours for Victory."

This is a typical story of America's Apostles of the Impossible, the inventors, the builders and the basement-bench Edisons who have submitted to the Council more than 50,000 ideas and inventions in less than 24 months. All have been carefully examined, hundreds are today being tested, and scores are actually at work winning the war and strengthening America's production lines for the peacetime pull ahead . . . But America needs more!

We at Jones & Lamson have a fair share of "apostles." They are attracted to our kind of work. Through more than a century of our history, these men, with visions of impossible things, have helped to design and develop a formidable list of America's great inventions and many of the basic machine tools in the front line of industry today. We've learned to respect their ideas, from the simplest suggestion to the most complex design — on the assembly line and in the laboratory — and we're urging them to help the government by submitting all promising plans to the National Inventors Council.

We hope that you too are seeking out such men, and helping to mobilize their inventive genius for the protection of the country — and the company — they're working for in this emergency.

For any counsel or assistance that we can give to you or to any individuals in your company on ideas involving the use of precision machine tools, Jones & Lamson engineers and service men are at your call.

Universal Turret Lathes . Fay Automatic Lathes . Automatic Thread Grinders . Optical Comparators . Automatic Opening Die Heads

JONES & LAMSON MACHINE CO., SPRINGFIELD, VERMONT, U.S.A.

Profit-producing Machine Tools

Helicopter Development Sponsored by Army Air Forces

As a result of tests, a production order has been placed with the Sikorsky Aircraft Division of United Aircraft Corp. and production models will be subjected to tests under field operating conditions. The helicopter is of welded tubular construction, with two rotors; one approximately 36 ft. in diameter operating on top of the fuselage, the other operating in a vertical plane at one side of the tail. Power is furnished by a Warner radial engine, through gears and shafts to the two rotors. Approximate length is 33 ft. and height is 12 ft. Gross weight is 2400 lbs.

Obituary

Walter Kidde, 65, founder and president of Walter Kidde & Company, died suddenly at his home in Montclair, N. J., on Feb. 9.

William E. Bee, 72, one of the founders of the Palmer-Bee Co., Detroit, manufacturers of power transmission and material handling equipment for the automotive industry, died Feb. 9 in Detroit as the result of a fall in his home.

Harold W. Wurster, 51, secretary-treasurer of the Murray Corp. of America, died Feb. 12 in Detroit after a long illness. He was secretary of the C. Harold Wills Co. before joining the Murray Corp. 15 years ago.

Lawrence Gotfredson, founder of the American Auto Trimming Co. and the Gotfredson Truck Co., died Feb. 13 at his home in Detroit after a short illness. He founded both companies with his brother, the late Ben Gotfredson. He actively directed the truck concern from 1925 until 1933, when he retired.

Edward N. Hodges, 82, traffic manager of the Hupp Motor Car Co. from 1910 to his retirement in 1935, died Feb. 5 at Detroit.

40 YEARS AGO

"Will the motor wagon supplant the horse in delivery work and trucking?" is a question which has recently claimed considerable attention in automobile circles, especially in connection with the organization of the commercial vehicle trails by the Automobile Club of America. There was formerly no doubt on this point among devotees of this new form of locomotion, and that the question is raised now can only be explained on the assumption that the comparatively slow progress which is being made with commercial motor vehicles has influenced opinion regarding the ultimate commercial practicability of the automobile in this field. There is at present not one firm entering the manufacture of motor delivery wagons and trucks to a score entering the manufacture of pleasure automobiles.

MEN . . . . . .

Joseph D. Stiles has been appointed manager of the newly formed Wickwire-Spencer Aviation Corp., a subsidiary of Wickwire-Spencer Steel Co. He was formerly with Mack Truck Co.

Bristol Co. announces the following appointments: **L. G. Bean**, vice-president in charge of engineering and sales; **Harry E. Beane**, sales manager, and **E. L. Stilson**, assistant sales manager.

Dr. G. M. Butler has been named chief metallurgist in charge of technical control and research in the Allegheny Ludlum Steel Corp.'s Dunkirk, N. Y., plant. **R. T. Eakin** has been named assistant metallurgist at the same plant.

John M. Davies, in the research division of The B. F. Goodrich Co. since 1926, has been named director of physical research.

Appointment of **Gunnar B. Taub** as superintendent of the Cardox plant manufacturing its airport fire trucks, has been announced by Cardox Corp., Chcago. Appointment of **Dr. P. W. Leppla** as chief chemist of its research division is also announced by Cardox.

Fred W. Climer has returned to The Goodyear Tire & Rubber Co., after serving with the WPB for several months. He will be assistant to E. J. Thomas, president of Goodyear, in charge of personnel activities of the company.

Aircraft Parts Development Corp. has announced the appointment of **Jack Sandler** as chief plastics engineer.

Tung Sol Lamp Works, Inc., has made the following personnel announcements: **G. A. Bodem**, sales manager for radio tubes, lamps and special products. He was formerly in charge of exports and radio tube equipment sales. **W. B. Masland** as manager of the recently combined market research and advertising departments. He is temporarily with the WPB in Washington.

Captain Nelson W. Pickering, USNR, has resigned as president of Farrel-Birmingham. He has been ordered to active duty with the United States Navy.

Arthur G. Prangley has been appointed secretary and legal counsel of the Elastic Stop Nut Corp. of America.

J. Warren Kinsman has been appointed assistant general manager of the Organic Chemicals Dept. of E. I. duPont de Nemours & Co. **Dr. J. A. Almquist** will succeed Mr. Kinsman as assistant general manager of the plastics dept.

Lincoln R. Scafe, vice-president and general manager of the Glenn L. Martin-Nebraska Co. will return to the G. L. Martin Co. at Baltimore and **G. Tom Willey**, former inspection manager at Baltimore, will succeed him in Nebraska.

Announcement of the election of **Warren F. Fryburg** as a director and vice-president has been announced by the directors of The Black & Decker Electric Co. of Kent, O.

L. W. Christenson has been made sales manager of the Cleveland Graphite Bronze Co. **W. G. Laffer** has been appointed chief of the company's newly established planning dept. and **D. R. Schoales** has been made treasurer.

J. Raymond Bell has been appointed director of advertising and public relations for Pennsylvania-Central Airlines.

The Board of Directors of the Pennsylvania Rubber Co. announce the election of **P. C. Mathewson** as vice-president in charge of factory operation.

John B. Walker has been elected a director of the Aircraft Accessories Corp.

Announcement has been made of the appointment of **Ralph R. Kimes** to the position of general manager of Aircraft Tools, Inc.

Albert H. Eggers, vice-president and sales manager of Greenlee Bros. & Co., has been named president of the company to succeed **George C. Purdy**, who becomes chairman of the board. **Leslie H. Geddes**, assistant sales manager in charge of screw machine sales, has been named second vice-president, and **O. Vincent Haegg** becomes secretary of the company.

(*Turn to page* 48, *please*)

Vought-Sikorsky Reorganized

The United Aircraft Corp. has restored its two original airplane manufacturing divisions, the Chance Vought Aircraft Division and the Sikorsky Aircraft Division, which have operated as Vought-Sikorsky Aircraft since 1939. The Chance Vought Division will concentrate on the development and production of combat types of aircraft and the Sikorsky Division will carry on the development of the helicopter for military and commercial purposes. Igor I. Sikorsky will continue as engineering manager of the Sikorsky Division and Rex B. Beisel has been named engineering manager of the Chance Vought Division. Both divisions will continue to operate under the general management of Charles J. McCarthy and will jointly occupy existing office and factory facilities at Stratford, Conn.

Four New Divisions of T-A Center at Detroit

Four product divisions have been set up within the office of Brig.-Gen. John K. Christmas, assistant chief of the Ordnance Dept. Tank-Automotive Center at Detroit, and a director has been named to act with full authority for each division. These division directors are Henry H. Howard, formerly a production executive with Caterpillar Tractor Co., director for tanks and combat vehicles; Col. E. S. Van Deusen, transport vehicles; Col. Graeme K. Howard, parts and supplies, and C. B. Smith, tools and equipment. These directors will work closely with the five basic functional branches of the center —engineering, manufacturing, development, maintenance and supply.

Valerius Kendall, formerly director of parts and supplies, has been appointed to direct the Tank-Automotive industrial integration committees. Other new appointments are Col. W. E. Niles as executive officer, Col. Barrett Rogers as assistant chief of the control branch, and Lieut.-Col. George E. Levings as chief of the administration branch.

Plants Not Greatly Affected By 48-Hour Work Week Order

Factory Workers' Wages Up 40 Per Cent Since January, 1941, 60 Per Cent Since September, 1939

Detroit, Akron and Dayton are the automotive war production centers among the 32 cities of the nation included in President Roosevelt's executive order of Feb. 9 placing plants and factories in those areas on a minimum work week of 48 hr. Aircraft production centers covered by the order for critical labor shortage areas include Hartford and Bridgeport, Conn., Buffalo, Baltimore, Wichita, Kan., San Diego, Cal., and Seattle. Employers who cannot make full use of their personnel on a 48-hr basis by March 31 must arrange after that date to release some of their employes for jobs elsewhere through cooperation with the local representative of the War Manpower Commission.

The order did not have much effect upon Detroit's war plants. An OWI survey covering 29 of the largest manufacturers with 36 per cent of the employment in the Detroit area showed all were working at least a 48-hr week. Some plants work up to 60 hr a week. However there are exceptions due to material and other considerations. The UAW-CIO recently charged that operations at the DeSoto bomber assembly plant were being held down to a five-day basis for 2000 employes because of inability of the Glenn L. Martin-Nebraska Co. at Omaha to complete final assemblies. DeSoto, along with several other Detroit plants, makes airframe subassemblies for the Martin B-26 bomber, which is being assembled at Omaha in a government-built plant.

Number of workers released for war industry as a result of the 48-hr week order is not expected to be great in the Detroit area due to the present full utilization of labor. However, Fowler W. Harper, deputy chairman of WMC, estimated the national average work week in war industry at 45.7 hr and said that 1½ million workers might be released if all industrial workers were moved up to the 48-hr figure. Men already are being trained to serve on manpower utilization efficiency boards to see that companies make the most effective use of their labor. Retired engineers are being sought for this work, which will require about 200 experts.

Most workers in the Michigan war plants have had their wages increased upder the "Little Steel" formula, which prescribed a 15 per cent advance in hourly rates between Jan. 1, 1941, and May 1, 1942, to compensate for a 15 per cent increase in the cost of living during that period. James F. Byrnes, economic stabilization director, pointed out in his radio address of Feb. 9 that the average weekly earnings of factory workers have increased 40 per cent since January, 1941, and more than 60 per cent since September, 1939. Taking into account the rise in living costs, the actual purchasing power of the average industrial worker is still 36 per cent more than it was in September, 1939.

The number of strikes in Michigan plants appears to be on the decline after a sporadic outbreak of unauthorized walkouts in the closing months of 1942. There were only 13 strikes in Michigan in January, according to the State Labor Mediation Board, 11 of them in war plants and six of them unauthorized. Chief perpetrator of the so-called authorized strikes is the Mechanics

(*Turn to page* 46, *please*)

Business in Brief

Written by the Guaranty Trust Co., New York, Exclusively for AUTOMOTIVE AND AVIATION INDUSTRIES

Relatively stable levels of general business activity are currently indicated. The seasonally adjusted index of *The New York Times* for the week ended Feb. 6 rose to 136.4 per cent of the estimated normal from 134.4 for the preceding week, as compared with 136.6 a year ago. The index of *The Journal of Commerce*, without seasonal adjustment, for the same period advanced one fractional point to 128.3 per cent of the 1927-29 average.

Department store sales during the week ended Feb. 6, as reported by the Federal Reserve Board, were 19 per cent above the corrsponding level in 1942. For the period of four weeks then ended, the total was 5 per cent greater than a year ago.

Railway freight loadings during the week ended Feb. 6 totaled 755,386 cars, 2.8 per cent more than for the preceding week but 3.7 per cent less than the number a year earlier.

Electric power output during the week ended Feb. 13 declined more than seasonally but was 15.1 per cent greater than a year ago, as against a similar excess of 14.0 per cent shown for the week before.

Crude oil production in the same period averaged 3,870,800 barrels daily, 17,450 barrels above the figure for the preceding week but 291,500 barrels less than the average output recommended by the Petroleum Administration for War.

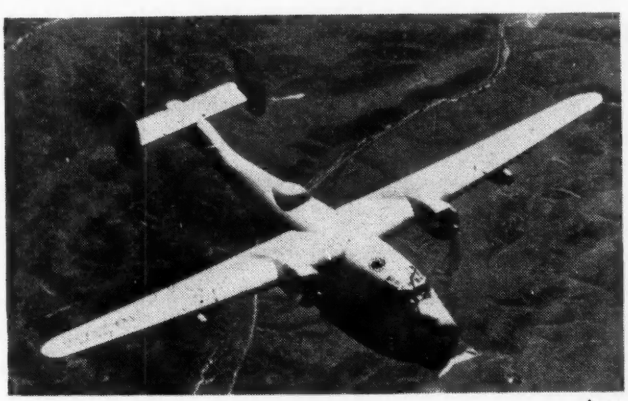
Average daily production of bituminous coal during the week ended Feb. 6 was 1,978,000 tons, as compared with 1,887,000 tons in the week before and 1,793,000 tons a year ago.

Engineering construction contracts awarded in the week ended Feb. 11, totaling $70,939,000 were 32 per cent below the corresponding figure in 1942, according to *Engineering News-Record*.

Business failures in the week ended Feb. 11 numbered 84, as compared with 82 in the preceding week and 210 in the corresponding period last year, according to the Dun & Bradstreet report.

Professor Fisher's index of wholesale commodity prices for the week ended Feb. 12 rose two fractional points to 110.7 per cent of the 1926 average, as against 102.6 a year ago.

Member bank reserves declined $195,000,000 during the week ended Feb. 10, and estimated excess reserves fell $60,000,000 to a total of $1,640,000,000. Business loans of reporting members rose $2,000,000 in the same period and stood $939,000,000 below the total a year earlier.



This Consolidated Aircraft Corp. Model 31, prototype of the P4Y-1, is said to be the fastest flying boat ever built in America.

Acme

Ryan to Produce New Type Plane

Ryan Aeronautical Company, San Diego, Cal., has revised its manufacturing program to include a "new and highly important combat plane," ordered by the Navy, T. Claude Ryan, president, announced.

Ryan said that the firm's production program was being altered in line with developments in the various theatres of war.

The revision necessitates a tapering off of the Ryan SOR-1 Navy Scout Observation Plane. In the transition period of the development of the secret new plane Ryan will turn out major subassemblies for prime contractors. The new program will require an increase in the number of workers and expansion of manufacturing buildings and facilities, Ryan said.

Hydrocyanic Acid Causes Explosions

Writing in *Metal Progress*, Albert M. Portevin, the noted French metallurgist, states that in France and Germany, where coal gas carried in pressure vessels is used extensively as a motor fuel, a considerable number of explosions of such pressure vessels have occurred as the result of corrosion cracking. Explosions occur either while charging or in service, and generally after the pressure vessel has been in use for a few years. These explosions have been more frequent with thin-walled pressure vessels of alloy steel than with the thicker-walled vessels of carbon steel. These failures have been traced to the presence of hydrocyanic acid in the coal gas. To prevent such failures, the gases must be purified as completely as possible and cooled so that the products which attack the steel will condense out before the gas is charged into the cylinders.

CALENDAR

Conventions and Meetings

Natl. Standard Parts Assoc., Chicago, Winter Conference.....March 2-5

American Society of Tool Engineers, Milwaukee, Annual Meeting March 25-27

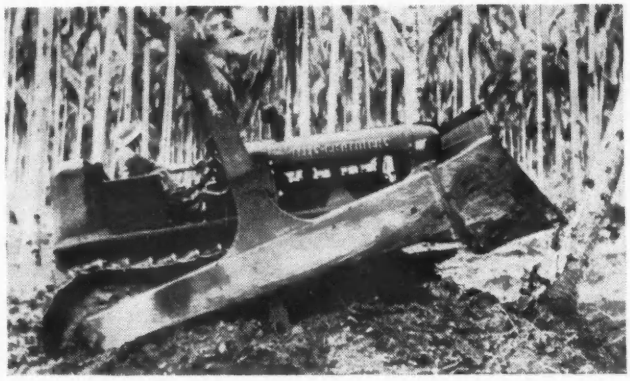
Export Managers Club of N. Y., New York City, Annual Meeting...March 30

Midwest Power Conference, Chicago April 9 and 10

American Chemical Society, Detroit, Annual Meeting .....April 12-16

American Foundrymen's Association, St. Louis, Annual Meeting..April 28-30

Midwest Safety Conference, 21st Annual Meeting, Chicago.....May 4-6



Acme

A bulldozer engaged in building a road on Guadalcanal. It speedily levels jungle growths that would take weeks to be cleared by hand.

Willow Run Production Up

(*Continued from page* 39)

believed, however, that, once started, Willow Run would soon achieve such a volume of production that it would in a given time overtake the production of a smaller plant using aircraft methods and would accomplish much greater production in the long run. The time needed to produce the first bomber was greater than was anticipated. There is no question that production could have been started at Willow Run many months soner had more conventional methods of tooling been followed."

Ford engineers followed automotive practice in using cast steel for forming dies. The Ford tool and die shop has the most extensive facilities in the industry, including a battery of 23 Keller machines. These steel dies could be made faster than casting kirksite dies, such as those generally used in the aircraft industry. In addition, Ford was able to call on more than 50 automotive tool and die shops in the Detroit area that were experienced in this type of die making. Ford uses some kirksite dies for blanking and piercing operations on light material.

However, this type of tooling affects the problem of design changes, according to the OWI report, which said, "Another factor that will determine Willow Run's future production will be the number of changes necessary in the bomber. It is much more difficult and time-consuming to make changes under Willow Run's tooling methods than under that of aircraft plants." The aircraft industry has found kirksite and rubber dies less expensive and taking less man-hours of labor than steel dies. However, the steel dies make for greater interchangeability of parts.

The B-24 bomber contains more than 1,250,000 parts, including 700,000 rivets, and once required 200,000 man-hours to manufacture. Production man-hours are expected to be cut by more than 80 per cent when volume output is achieved. Each bomber requires 17,000 feet of electric wiring and 350 yards of fabric, the latter accounting for a sizeable sewing machine department. More than 900 different shapes and sizes of tubing are formed in the plant.

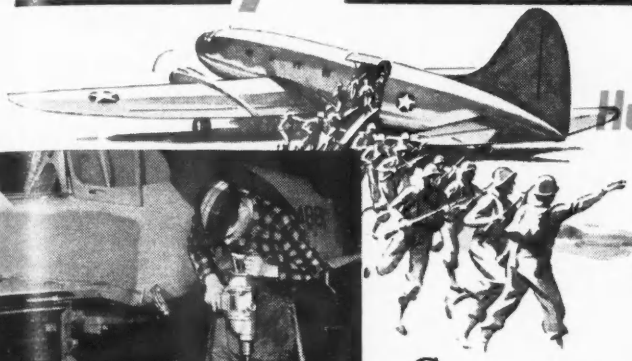
Four secondary assembly lines are supplied by overhead conveyors from the manufacturing section with a constant flow of bulkheads, hat stringers, belt frames, floors, bomb and hatch doors, skin and stringer assemblies, fuselage panels, center wing flaps, ailerons, leading and trailing edges and tail surfaces. There are 12 stations on the secondary assembly lines. The 55-foot center wing sections are fabricated on 30-ton fixtures whose rigidity assures meeting stiff inspection standards. The center wing sections undergo 26 milling operations on a huge Ingersoll machine that proves a great time saver in production.

The four secondary lines finally merge into two final assembly lines where the planes begin to take shape as the wings are joined to the fuselage, which has been assembled from the forward and the aft sections; the landing wheels are attached, the bombardier's enclosure and gun turrets are installed, the four engines descend from an overhead balcony to their proper places, and the tail surfaces are added. The propellers are installed and then the planes go through a huge paint booth where the distinctive khaki of the Army Air Forces is applied. A thorough government inspection follows, after which the plane is fueled and wheeled out on the adjoining 1,200-acre airport for flight testing. An eight-section hangar, with 45-ton sliding doors, can accommodate 20 B-24s.

The labor supply is one of the biggest restricting factors in Willow Run's production. Four hundred new employes could be added every day if they were available. However, sometimes the number of "quits" exceeds the "new hires." Labor turnover has been excessive, more than 10,000 workers having quit their jobs in the last 8 months. Probably more than half of these left to join the armed forces. A majority of the remainder quit due to the transportation difficulties involved. An increasing percentage of the total employment is now

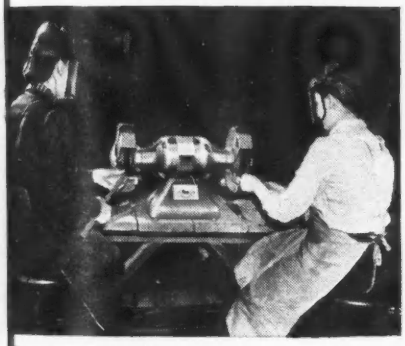
(*Turn to page* 46, *please*)

Speeding Deadly "Warhawks" into the Air

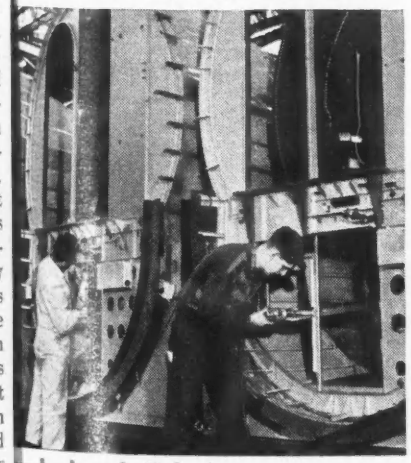


Hurrying Giant "Commandos" to take 'em There!

Getting 'em to War Fronts Faster with Black & Decker help. Entire fuselage of each *Warhawk* is crated for shipment to theatres of war. Husky Black & Decker ½" Drills like this are used for boring through shipping crate seams on fast, 'round the clock schedules.



Women Team Up at B & D Bench Grinder to keep planes rolling. Operator at left is brushing ¾" aluminum angles, operator on right is re-brushing small aluminum rods to remove burrs. A battery of these 10" Bench Grinders keeps material flowing to production lines.



Hundreds of Holes in huge *Commando* cases are drilled in record time with humming Black & Decker Holguns. Because all of the pilot's controls are housed in these massive nose sections, scores of holes must be drilled for the installation of control and instrument panels.

CURTISS-WRIGHT'S newest and deadliest *Warhawk* fighter planes and their giant new *Commando* cargo transports, are filling the air over the world's fighting fronts in swiftly mounting numbers. Playing no small part in this record production are thousands of husky Black & Decker Electric Tools, humming night and day at the Curtiss-Wright plants, helping speed the output of these vitally needed planes.

The pictures here show how Black & Decker Tools are doing many important production jobs —jobs that are being done throughout the entire aircraft industry today. They show why aircraft plant production experts say, "You can do the job faster and better with Black & Decker Electric Tools."

This story is another example of the American system of free enterprise at work . . . of close and voluntary cooperation between aircraft builder and electric tool manufacturer . . . of free men uniting their efforts and ingenuity in the common cause of producing more and better weapons to help win this fight for freedom.

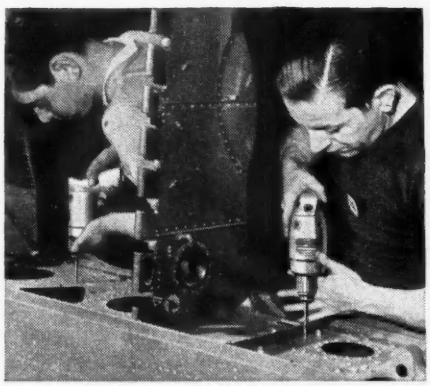
Need Expert Help?

Your nearby Black & Decker Distributor can give you expert help on tooling problems. He is dependable and convenient, as a source of supply or information on any tooling problem you may have. The Black & Decker Mfg. Co., 781 Pennsylvania Ave., Towson, Md.

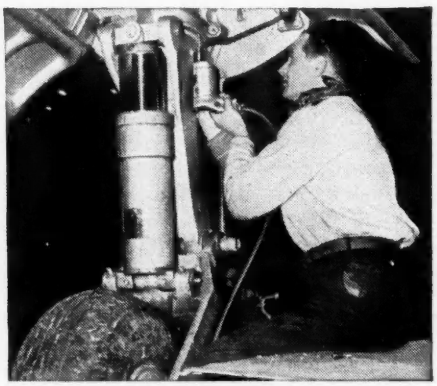
LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC **TOOLS**



Curtiss-Wright Production Lines are alive with the aircraft industry's most used electric drill . . . Black & Decker's famous "Handful of Power" Holgun. Hundreds of them are used to drill wing sections (shown here) of these deadly Curtiss-Wright *Warhawks*.



From Nose to Tail-Wheel of giant *Commandos*, thousands of holes need to be drilled on fastest schedules possible. Black & Decker Holguns are "musts" in the production of these huge "flying boxcars." Here operator is drilling with Holgun to install a tail-wheel mud guard.

women. The plant is 20 miles from downtown Detroit, having been built away from cities in order to provide a good airport. Many workers travel 20 miles to and from the job daily. The transportation problem has been made more acute by one of the severest winters in 20 years, with much snow, cold weather and icy roads. Group riding has been handicapped by the constantly changing personnel. The housing situation within a 15-mile radius is acute, with many workers living in trailers, shacks and jerry-built homes. Some new dormitories are being completed for both men and women, which eventually will accommodate 10,000 workers, but a lack of coordination between city, county and federal governments on housing needs has greatly hampered this development. Very few of the new workers have had factory production experience. More than 15,000 already have been trained and a $500,000 school building at the plant has some 3,800 employes now enrolled in various courses taught by 165 instructors. The number of workers transferred from the Rouge plant has been small.

Plants Not Greatly Affected By 48-Hour Work Week Order

(*Continued from page* 43)

Educational Society of America, an independent union claiming 42,000 members, mostly in skilled or semi-skilled capacities. Under the leadership of Matthew Smith, stormy petrel of Detroit Labor, whose failure to become a U. S. citizen after years of residence here makes him a frequent target of newspaper editorials, the MESA has refused—during the war emergency—to agree to the no strike pledge which the leaders of the AFL and the CIO have promised.

Four strikes in one recent week involved plants whose workers are affiliated with the MESA, including the Parker Wolverine Company and three small tool companies. In an NLRB election at the Parker Wolverine Ordnance plant, following the strike, the UAW-CIO defeated the MESA 266 to 89, but Smith protested that most of his members had been laid off before the election. Two of the strikes were in protest against the failure of the newly established regional War Labor Board at Detroit to give representation to the MESA, although the CIO and the AFL both are represented among the labor members. Smith was called before a three-man panel of the WLB after Edwin E. Witte, board chairman, condemned his defiance of the National no-strike policy. Smith agreed to see if the board would give the MESA a "Square Deal" and ordered men back to work at the two plants. The two cases involved were referred to David A. Wolff, public member, acting as a one man panel.

Members of the newly appointed regional WLB are Edwin E. Witte, chairman; David A. Wolff, Detroit attorney, asst. chairman. Industry members: C. A. Cahn, exec. secretary of the Automotive Tool & Die Manufacturers Association; Frank Rising, general manager of the APEM; W. J. Cronin of ACWP; Willis H. Hall, Detroit Board of Commerce; J. L. Lovett, general manager of Michigan Manufacturers Association; Clifford Hale, Manufacturers Association of Jackson. Public members: T. J. Donahue, chairman of Michigan Labor Mediation Board; F. H. Bowen, Regional Director of NLRB; Dr. H. S. Patton, head of Michigan State College Economics Dept.; Prof. I. L. Sharfman, chairman of University of Michigan Economics Dept. Labor members: E. R. Smith, president of Muskegon Central Labor Union; M. L. Bishop, W. S. Stevenson, Leo LaMotte and Richard T. Leonard, executive board members of UAW-CIO; Ray Carroll, Sol Sniderman and Archie Virtue, all representing AFL craft unions.

The Army took action in one of the MESA strikes when Colonel George E. Strong, chief of Plant Protection for the Army Air Forces in the Central Procurement District, ordered six members of a picket line at the Eclipse Conterbore Company barred from returning to work until their citizenship had been investigated. Firing of two men at the Buick Aluminum Foundry at Flint last August following a slow down and two day wildcat strike has been upheld by Allen Dash, Jr., umpire under the General Motors UAW-CIO contract. The men were ordered suspended by Colonel Strong after they were held responsible for holding up aircraft parts production. Buick refused to rehire them and the case went to Dash. An inquiry by Colonel Strong into the strike of maintenance employees at the Ford Rouge Plant Jan. 4, found that the walkout was the result of considerable confusion and misunderstanding that could not be laid to any single individual. Harry Ross, an international organizer for the UAW-CIO has been appointed administrator for the maintenance unit of Ford Local 600.

Dr. Harry Shulman, former professor of law at Yale University, has been appointed umpire under the contract between Ford Motor Company and the UAW-CIO. There was prolonged discussion to find a man for the job after Prentiss M. Brown, now director of OPA, and former Governor Murray D. Van Wagoner had been considered. Dr. Shulman headed a recent WLB panel on the Ford wage rate case.

CENSORED

An exclusive feature prepared by the London correspondent of AUTOMOTIVE AND AVIATION INDUSTRIES, M. W. Bourdon.

W. M. W. Thomas, latterly vice-chairman of Lord Nuffield's group of companies (of which Morris Motors is the parent concern), has been made a Knight by King George, on the recommendation of the Prime Minister, Winston Churchill, thus entitling him to be addressed as Sir W. M. W. Thomas. Thomas, who was an automobile journalist before he joined William Morris (now Lord Nuffield) as publicity adviser in 1924, is held in universal respect in the British automobile industry—no man more so. In succession since 1924 he has been general sales manager and a director of the Morris Motor Co., managing director of Wolseley Motors and Morris Commercial Motors (both Nuffield subsidiaries) and lately second only to Lord Nuffield in the Nuffield organization. Thomas holds the Distinguished Flying Cross gained while serving in the last war and is a member of both the S.A.E. and the (English) I.A.E. In December last he returned to England after one of his many visits to the United States.

All new casings made by British tire manufacturers henceforth will have a colored strip of rubber between tread and fabric. Hitherto only two or three makers have provided this means of giving visual warning of the need for a casing to be retreaded if it is not to suffer permanent harm. Retreaded tires will not be affected by this decision of the War Emergency Tire Manufacturers' Conference.

The Minister of War Transport asked the Public Service Transport Association for its views as to the classes of ex-bus workers, now in the Forces, who should be considered for early release when demobilization takes place. In response, the Association placed administrative staffs first, followed by maintenance and driving personnel and then conductors.

Lord Latham, chairman of the Singer Motor Co., at the annual meeting of shareholders, spoke of the uncertain outlook beyond the day when final and complete victory was secured. The problems of war, he said, would give way to the no less serious problems of peace and he would be a brave man who would venture to prophesy with any particularity what would be the condition of industry and commerce at home and abroad, short term or long term, or what the prospect would be for the construction and sale of automobiles.

Tens of thousands of additional tractors would be needed before British farmers were completely equipped for maximum food production and a maximum effort in the Battle of the Atlantic, said R. S. Hudson, Minister of Agriculture, speaking at a mass meeting of employees at an agricultural engineering plant. When the war started, he went on, Britain had about 53,000 farm tractors in use and we set out to double this number; but with a far bigger target in food production than was envisaged by anybody in 1939, we now required many more tractors than we thought originally would be needed. It may be added that the Ministry of Agriculture has warned farmers that they must cooperate much more than hitherto in the use of existing tractors and farm machinery in general, as there will not be enough of either in 1944 to allow every farmer the exclusive use of his equipment.

Buick Aluminum Foundry

(*Continued from page* 29)

skimmed off the ladle.

We mentioned earlier that one of the outstanding features of the Buick foundry is its sand reclamation system. Some of the details of this may well be given at this point. The operation really begins with the shakeout, is completed in the basement gallery.

After pouring, the molds are allowed to cool on gravity rolls and move up to the knockout stations. Individual molds then are crane lifted, reversed and placed pouring end down on 3 x 5 Simplicity vibrating knockouts. The casting is removed by hand and rough cleaned on an adjoining wood bench where much of the scrap aluminum is reclaimed. Rods are removed on the knockout and all sand pushed over one end into an open chute. As the knockout time cycle corresponds to that for closing and pouring, uniform production, free from bottlenecks, is maintained.

The knockout sand, including lumps up to 8 in. by 12 in., passes directly into cylindrical trunnion mounted breakers, installed by C. O. Bartlett & Snow, which are located in the basement—on breaker serving each knockout. No screening is attempted in these breakers but the internal construction is such that most of the discharged sand is sufficiently fine for re-use and carries few lumps as large as ½ in. x 2 in. A common system of belt conveyors carries such sand to a finishing breaker screen, after removal of stray rods, chills and fine wires by a magnetic pulley.

All fine sand passes through the outer screen of the C. O. B. & S. finishing breaker and, after magnetic separation of fine wires, it is elevated and conveyed to storage. The small percentage of ½ in. lumps remaining on this breaker screen are conveyed to a hammer mill and the resulting fines returned for screening. Operated thus as a closed system, no sand is wasted, virtually all being recovered for re-use. Scrap aluminum is hand picked from the belt feeding the mill but the amount is so small that only one picker is required.

Dust hoods are provided around the feed and discharge ends of all breakers and at all other points of sand transfer so that the entire basement is truly dust free. Compact side wall hoods, furthermore, are provided at each knockout point. Cylindrical dust collectors of the wet type are mounted in the roof trusses, all sludge being pumped into outside tanks for convenient haulage.

Although all knockout fine sand is suitable for re-use as backing sand, a certain percentage of the recovered sand is given further treatment to facilitate its re-use as facing sand. For this purpose, the black reclaimed sand is treated in a special unit supplied by Link-Belt. Here the sand is first calcined in Link-Belt oil-fired rotary kilns, then air-cooled in Link-Belt rotary louvered shells. This battery of equipment, together with elevators, belts and classifiers, is located in a separate building adjoining the concrete storage bins.

Since mechanization plays an important part in any mass-production operation, a brief comment may be made on the provisions for materials handling in various phases of the Buick foundry. For example, sand is delivered to the molding lines from two sand mixing rooms, each serving half of the core rooms. There are sixteen monorail conveyors for this purpose, with a developed length of 2720 ft.

Consider the elevator equipment found here. The sand shed contains five elevators for serving the belts and hoppers; six elevators are in the core sand mixing room; one return elevator from the sand mills in the basement; and one elevator for tailings from the mills.

The sand reclamation department, too, is well equipped for mechanical materials handling. First there is a belt line 349 ft in length from the reclaiming elevator to the reclaim storage bin in the shed. Sweepings under each oven chain are handled on return sand belts, making eight belts with a developed length of 1040 ft. In addition, there are the cross pick-up belts, a belt for delivering sand from the reclaim bin to the burner, five belts in the sand basement, and four belts for the return and distribution of burned reclaimed sand.

The foundry sections are generously endowed with overhead I-beam type monorail conveyor lines, fitted with suitably designed hooks for handling individual head castings. Lines 1, 2, 3 and 4 running from the shakeout, over the trucking aisle to the grinders and to the first Pangborn have a developed length of 1328 ft. Lines 5, 6, 7 and 8 running from the first Pangborn through the cleaning benches and to the second Pangborn have a developed length of 2360 ft. Lines 9 and 10 from the Pangborn to the water test, each one serving two molding units, have a developed length of 480 ft. The No. 1 conveyor line from the water test to the heat treating department, serving all four units, has a length of 620 ft. The No. 12 line from the heat treat to the final inspection and shipping runs 690 ft in length.

There are five ingot mold conveyors serving the Dempsey 10-ton melting furnaces, totaling 330 ft in length. Eight baking oven conveyor lines total 5632 ft. Four drying oven conveyor lines total 2480 ft; and four core assembly feeding conveyors used for stock and delivery of small cores run some 1376 ft in length.

In closing, it may be well to point out that by the use of dust collectors and the other features of good housekeeping expressed so well here, the Buick foundry is a model of cleanliness and order. It is safe to say that this foundry will surprise the casual visitor whose conception of a foundry operation may be based upon conventional foundry practice. Not the least of the reasons for good housekeeping is the huge basement gallery under the main area of the foundry which is used as a storeroom for all supplies.

Moreover, all lockers, washrooms, and the cafeteria are located in the basement gallery, thus freeing the foundry proper from the usual effects of such activities.

A New Development in Two-Stroke Diesels

(*Continued from page* 31)

transmitted to the engine crankshaft through gears. Scavenging and charging air is supplied by reciprocating compressors built together with the engine. This engine has a one-hour rating of 1370 bhp at 750 rpm, which corresponds to a bmep of 170 psi. The fuel consumption is given as 0.35 lb per bhp-hr.

Most recently the six-cylinder engine illustrated in Fig. 2 has been developed. It is of the double-piston, two-crankshaft type, the upper and lower crankshafts being connected by a train of gears. The bore is 7.09 and the stroke of each piston 8.86 in., and the engine has a one-hour rating of 1560 hp at 850 rpm, supercharged to 2 atm abs. Fig. 3 is a sectional elevation of a corresponding eight-cylinder engine (7.09 in. bore and 2 x 8.86 in. stroke) which is designed to be supercharged to 2.5 atmospheres to develop an mep of 192 psi and an output of 2750 hp at 1000 rpm (one-hour rating).

Where very high charging pressures are to be employed, so that all of the power generated in the Diesel cylinders is required to compress the air, the engine can be built in the form of a free-piston engine. Each of the opposed pistons of the Diesel part then is built together with a compressor piston which compresses the scavenging and charging air. No crankshaft is needed, the two pistons being merely coupled together by a linkage which ensures phase equality of the piston motions.

This power-gas system, it would appear, affords another opportunity for the development of a practical gas turbine. It is claimed that with a power-gas temperature of between 850 F and 940 F at the entrance to the turbine, a thermal efficiency of between 35 and 40 per cent can be achieved without resorting to the use of recuperators and other special apparatus, which is about twice that of the constant-pressure turbine operating with gas at about 1000 F.

Refining of Used Crankcase Oil

(*Continued from page* 24)

ture, etc., and maintained at such temperatures for a sufficient length of time to insure proper clay contact. The heat and vacuum are then turned off, and the earth and oil are allowed to flow by gravity through coils in mixing tank *A*, acting as a heat exchanger, to contact tank *C*, where a filter aid is added. It is then pumped through a plate-and-frame-type filter press *D*, with the filter cloths preceded and/or backed up by a paper filtering medium. The vapors are drawn from the still by vacuum through a condenser *E* to a run-down or distillate tank *F*.

The vacuum used in the process is produced by passing the water, which has acted as coolant for the condenser, through an inverted-type steam jet. Any type of filtering earth, such as fullers' earth, may be used in the contact treatment. Recently two types of activated earth have been used. Magnesol and Retrol, the latter now being the Airlines' standard material. These have the advantage over raw earth that only one-half the amount of material needs to be handled. For a filter aid, either J-M Hyflo Super Cel or a similar product manufactured by Dicalite may be used. To provide the steam required for the stripping operation, water may be injected through a needle valve, or steam may be injected directly. Operating temperatures are governed by the grade of oil being rerefined, the type of earth used, and the condition of the drainings. However, it can be said that for most aircraft oils temperatures ranging between 475 F and 600 F are satisfactory. Several trial runs at the time the unit is installed will serve to determine the optimum temperature, by running such control tests as viscosity, flash, fire, emulsion, gravity, etc., American Airlines at present goes to a maximum of 525 F, steam-stripping from 425 F on up.

Accompanying the paper was a table giving analyses of a number of used engine oils. The total sludge content usually ranged between 1 and 1.5 per cent, of which 15 per cent was tarry matter, 45 per cent carbon and carbonaceous material, and 40 per cent inorganic matter such as silica and lead compounds. Neutralization values usually are higher than in new oil, and must be corrected. There is seldom any dilution as such, unless the Army hopper system is used for cold-weather starting, or the used oil has been drained from the lower-output engines. In the case of American Airlines, most of the oil is drained from the higher-output engines, and for this reason the rerefined oil is allowed to have a viscosity at 210 F of approximately 5 sec. higher than the new oil currently being used.

An idea of the cost of rerefining crankcase oil can be obtained from the table on page 24, which is based on operations of American Airlines when using a new oil containing an additive, and the total-cost figure there given is said to be about five cents per gallon higher than it would be if straight mineral oils were being treated. The depreciation figure is based on a five-year life when operating at approximately one-half the maximum production capacity of the unit. Labor costs possibly may be increased by from one to two cents per gallon under present conditions.

MEN

(*Continued from page* 42)

Wolverine Tube Div. of Calumet and Hecla Consolidated Copper Co., has announced the appointment of **A. G. Dennison** in charge of the Detroit office of the company.

Henry T. Riddick has been named sales service manager of The Osborn Mfg. Co.'s brush division. He will also continue to serve as credit manager.

The following Studebaker appointments have been announced. **S. A. Skillman** as manager of the New York Branch and **E. J. Cremins** as regional manager for the Pittsburgh area.

Charles L. Huston, Jr., has been appointed assistant to the president of Lukens Steel Company. **W. Roy Widdoes** has been named director of personnel relations to succeed Mr. Huston.

Igor I. Sikorsky, aircraft designer and engineer, has been elected an Honorary Fellow of the Institute of the Aeronautical Sciences, Inc., and has been chosen to receive its annual Sylvanus Albert Reed Award for 1942. Mr. Sikorsky is engineering manager of the Vought-Sikorsky Aircraft Div. of United Aircraft Corp.

R. E. McDonald has been appointed advertising manager of The Dumore Co. of Racine, Wis.

W. F. McGuinness has been named a vice-president of Elastic Stop Nut Corp. He will continue to function as treasurer.

Chain Belt Co. has elected **A. R. Abelt** a director and vice-president of the company. **G. D. Gilbert,** sales manager of the Baldwin-Duckworth Div. of Chain Belt, at Springfield, Mass., has been made general manager of that division and also elected secretary to succeed Mr. Abelt.

The C. O. Bartlett & Snow Co., Cleveland, has announced the appointment of **M. E. First,** formerly chief engineer, to be director of the Foundry Equipment Dept. and the election of **Henry A. Christy** to membership on the Board of Directors.

Pesco Div. of Borg-Warner announces the election of **N. M. Forsythe** to the position of vice-president in charge of sales.

Walter E. Gibson has joined the advertising staff of Detroit Rex Products Co. He was formerly advertising manager of the Swartzbaugh Mfg. Co.

D. P. Brannin has been appointed district sales manager of the Pigment and Metal Sales Divisions of New Jersey Zinc Sales Co. in the Chicago area. **J. P. Dunphy,** of the New York Sales Dept. has been district sales manager, Pigment Division, with headquarters in New York City.

J. H. Cooper has been appointed chief of the Resistance Welding Section, General Industrial Equipment Div., WPB, Washington. He has been given leave of absence by the Taylor-Winfield Corp., Warren, Ohio.

Charles J. Durban has been appointed assistant director of advertising for United States Rubber Co. He will continue to supervise all tire advertising in addition to his broader company duties.

G. Donald Kennedy has resigned as Michigan's state highway commissioner to become vice president for highway transportation of the Automotive Safety Foundation, Washington.

C. Arthur Woodhouse, formerly vice president and treasurer, has been elected president of the Michigan Bumper Corp., Grand Rapids. He succeeds the late Byron F. Fortier.

C. S. Williams, formerly an executive of Thomas A. Edison, Inc., has been appointed director of the Controlled Materials Division of the Office of Civilian Supply, WPB. He has been with OPM or WPB since November, 1941.

Harold E. Talbott has resigned as director of the aircraft production division of WPB.

Sherrod E. Skinner, vice president of General Motors and on leave as general manager of Oldsmobile, has been appointed director of the new office of production scheduling in the Army's Services of Supply. He had been head of the SOS production division.

A. H. Paterson, general works manager of the Plymouth Division of Chrysler Corp., has been named a vice president of the division.

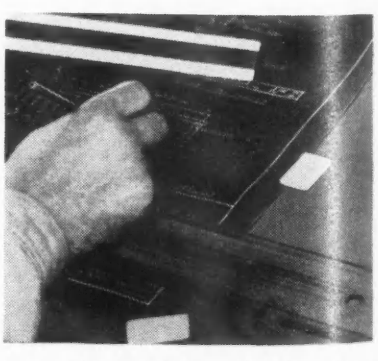
John W. Votypka, formerly director of engineering for Fruehauf Trailer Co., has been appointed head industrial specialist of the Production Service and Smaller War Plants divisions of the Detroit regional office of WPB. He has been associated with the automotive industry since 1913, when he started to work for Fisher Body Co.

R. W. Gallagher has given up the post of board chairman to become president of Standard Oil Co. of New Jersey, succeeding the late W. S. Farish.

W. Dean Robinson, vice president of Briggs Mfg. Co., has been elected a director of the National Bank of Detroit.

Fasteners Eliminate Use of Thumb Tacks

A new method of attaching drawings and blueprints to drawing boards, which eliminates the necessity of moving the T-square over thumb tack heads, is the use of Kum-Kleen Stickers, made by Avery Adhesives, Los Angeles, Cal. These paper-thin stickers, which lie flat, are applied without moistening, and are easily peeled off without leaving a mark or affecting the surface to which they were attached. They are made in a variety of sizes and shapes.



Kum-Kleen Stickers holding blueprint to drawing board.

Floodlighting Unit

Steel or cast-iron parts, treated by porcelain enameling and other rust-proofing, have replaced those formerly made of non-ferrous metals and alloys in the Type RDS floodlighting projectors offered by the Benjamin Electric Mfg. Co., Des Plaines, Ill. These models have a silvered mirror crystal glass reflector and are provided with an adjustment for regulating the width of the beam. The new units are furnished in two models: The RDS 14 for 300 watt and 500 watt general service lamps or 500 watt floodlighting lamps, and the RDS 18 for 750 watt and 1000 watt general service lamps or 1000 watt floodlighting lamps.

World-wide Field Service

(Continued from page 25)

Silver pre-fitted bearings have replaced copper-lead bearings in the engines as the result of operating experience. The silver bearings prolong engine life and are easier to service. As a result of improvements such as this, the period between engine overhauls has been extended 50 per cent in the last year.

Field service men on foreign duty have the fortune (or misfortune) of war to reckon with as well as the normal troubles that beset marine engine operation. Jack McCabe, who was stationed at the Cavite naval base near Manila when war came, saw all the spare parts and engines for the PT boats there destroyed by Japanese bombs. An old barge in the harbor had to be used as a base to make repairs on the small PT squadron that survived the bombing. This was further complicated by the fact that fifth columnists had sabotaged the oil and gasoline supplies and wax fouled the gas lines. Only a top overhaul of the engines could be made due to lack of facilities and equipment. But despite these handicaps four of the boats were put in operating condition—and it was this squadron, led by Lieut.-Commander John Bulkley, that rescued General MacArthur from Corregidor.

William McCombe, a veteran Packard marine engine expert, spent several months in England in an advisory capacity on installation as Service Representative looking after any serious mechanical problems. The English marine mechanic must exercise his judgment as to whether time should be taken to make repairs to an engine or whether the entire engine should be replaced. The PT and MTB motor torpedo boat craft in England must be kept mobile for fear of enemy bombers. A boat cannot be lifted out of the water for more than 1½ or two hours at a time due to the constant threat of Nazi planes. So far none have been hit.

Parts depots and spare engines for marine installation are dispersed around the coastline of the British Isles so that German bombs will not wipe out any appreciable supply with a single hit or raid. Spare engines are stored within two hours of any operating base. The English marine repair bases also have their problems increased by the naval battles engaged in between the PT and MTB boats and the Nazi "E" boats and armed trawlers in the English Channel. Frequently a sweep of enemy gunfire across the decks will mean a row of bullet holes in the crankcase or cylinder jacket, thus necessitating installation of a new engine if and when a return to base is made.

Servicing of the powerful Packard marine engines has proved a major task in Britain. The usual marine repair shops are overloaded with aircraft work. The RAF has taken most of the skilled aircraft mechanics as ground personnel for the 1000-bomber raids on Germany. These men are best fitted to service an engine such as the Packard marine type due to its aircraft design. In the emergency, bus and transport companies have been called upon to do much of the marine overhaul work. Their mechanics are familiar with cast iron Diesel engines, so they have to adopt new methods in servicing an aluminum aircraft-type power plant like the Packard marine engine. Dirt is the biggest factor in running this type engine. The bus mechanics have to be educated to this kind of work.

English mechanics also are unfamiliar with the mass production methods of U. S. manufacturers. Precision bearings are a case in point. The English have been accustomed to rough and line bore their bearings, after which they had to be plated. Silver pre-fitted bearings make this unnecessary. The mechanics also have to be educated in the careful use of 100-octane gasoline, which powers the PT boats. This is especially volatile and cannot be used carelessly to clean parts. Great caution also must be exercised in filling the gasoline tanks due to danger of fire and explosion.

If a boat will not operate normally, usually the engine is the first thing to get the blame. McCombe was called to a port in Wales to look over a craft which would not perform up to par. The boat was turning up only 1600 hp., which was far below the potential peak performance. McCombe checked the engines and found them functioning satisfactorily. So he told the service crew to haul the craft out of the water. After some protest they did so and found a heavy deposit of shell encrusted on the hull. When this shell was scraped off, the boat was returned to the water and turned up the expected 2500 hp. without any effort.

McCombe expressed a maxim for the marine engine service men when he said, "You have to be like a country doctor finding out the patient's ills!"

What It Takes

(*Continued from page* 9)

production in the not far distant future at New Orleans.

Design to Production

The pattern from design to production takes is very complicated. First, we have a vast number of engineering hours. As we use these engineering hours, we are not only drawing designs for parts, but we are using a "mock-up" to decide where the different installations and many other things must go. Controls, hydraulic systems, landing gear assembly and other components are located. They are made to function approximately as they will in the prototype to come. Seats are arranged to allow for comfort, visibility and the saving of space. Instruments are grouped so they can be read quickly. Control panels are so installed that vital ones are immediately accessible. There are thousands of things to be considered, thousands of obstacles, relating to each other or even created by each other, to be overcome.

It is along in here that production engineering begins to make itself felt. The aerodynamists and preliminary design engineers are working mainly with the thought: "Will it fly as far and as fast carrying the load it was engineered to carry as we said it would?" The production design engineers are asking themselves: "Is the airplane simple to build? Can this huge, complex mechanism be broken down into very small jobs which can be done by inexperienced hands? What is it going to weigh and cost?" and many other questions. What's more, they are finding the answers.

When the mock-up has been approved, the next step is the actual construction of the prototype. The wise manufacturer makes at least three of each part which goes into the plane, so that parts can be used for testing, can be examined to see that they are not complex, and therefore can be manufactured by simple tooling and simple methods.

The Prototype Takes Form

Design and production engineering work, which started with the first drawing, continues unabated as the huge prototype takes form. Plant engineers are already thinking of the problems faced in building a structure to house assembly lines. It is apparent to them that no existing building is big enough to house such a behemoth. There must be a wider, longer structure, with columns spaced farther apart and with a higher ceiling. They are planning other smaller buildings, planning needed additions to the plant, and worrying about a lot of other things.

Orders for materials are being placed as the mock-up is approved; as the prototype is being flown successfully by test pilots, and the design engineers are taking the "bugs" out of the plane as the flights progress. Tooling up is under way. Sub-contractors are being contacted to see how many components they can build. The man-power situation is being studied. Has the supply of workers in the community been exhausted? If so, where can more be had?

Eventually everything is correlated. Building something big through the use of a great many people brings about virtually the same difficulties as building something small using comparatively few people. The principle is the same, but there are more and greater difficulties. I've just cited a few of them here.

From a production standpoint, however, we have learned that there are no insurmountable obstacles in building large planes. Mass production methods, such as the mechanized conveyor line, have been applied successfully to the manufacture of 28-ton Liberators. Today, the Coronado, weighing 33 tons loaded, having a wing-span of 115 ft. which is 5 ft longer than the Liberator, also is being built on a conveyor line.

From a standpoint of design, how large can airplanes be built? The preliminary design engineers at Consolidated tell me that, including the projected 400-passenger model, we have not in any contemplated designs reached a limit on size. In other words, as big as our designs now are, we are still going strong. To me, the question is not how large we can make the planes, but what is the most economical size? What is the most practical, efficient size?

The question is constantly arising as to what materials will be used in the large airplanes to come. It is my personal belief that steel will be used more and more as aircraft increase in size and weight. In addition to the material used in making a large airplane, it is very necessary to consider the type of construction.

One factor which must be stressed in design is whether or not the plane is readily serviceable. As we get into the building of the large planes, service problems arise, such as the facilities at points where the planes land to load and unload. We must have a plane which can be quickly and easily repaired and overhauled. This goes right back to design. With design simplified, we need suitably manned facilities along our routes. We must not only build them to fly, but build them so that they may be kept flying.

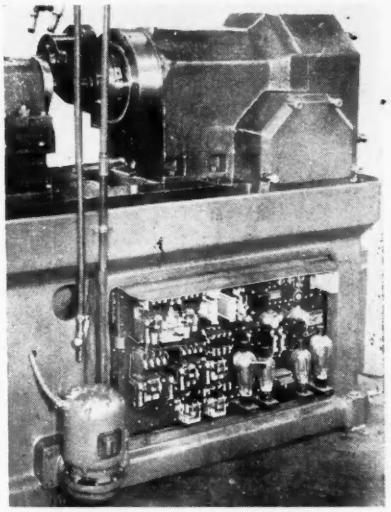
Another phase which must be considered, and which enters into the field of manufacture, is the possibility of converting wartime military models to peacetime needs. Revamped military

lanes will be strictly a compromise measure—a stop-gap, or fill-in operation. And, furthermore, it will be very temporary. This will be true even if the military planes can be bought up cheaply.

Even today, our military airplanes are built for high performance and specific missions. Fuselages are small, allowing them to carry just enough crew, armament and bombs to get there, do the job, and return as quickly as possible. For example, a fuselage 10 ft in diameter can carry a bomb load of 20 tons. It would have to be of much greater diameter to carry 20 tons of passengers or normal cargo. We have hung on tons of military gadgets; in fact, we have actually designed them into the military ships. After the war we must aim at economy of operation, as well as construction. To do this we must redesign and build new airframes. The longer the war lasts, the greater will become the gap between military and commercial designs. Although the gap between military and commercial types is widening, we will use the principles developed in war and adapt them to our commercial designs. We also will be able to standardize our designs to a greater degree and use them for several years. This is in direct contrast to our present daily changing to meet the constantly arising emergencies of wartime. Obviously, it will result in considerable economy.

I do not believe we will ever return to the custom-building of aircraft. In the period which is ahead of us—a period of fierce postwar competition—we will have to intensify our efforts to produce economically and efficiently instead of reverting to the old job shop methods. When I refer to mass production, I do not mean that we will have to produce airplanes by the tens of thousands and the hundreds of thousands as we are doing today. It is not necessary in mass production to do this. The same ideas we have developed to date can be applied readily to small batches of airplanes. And, even on one assembly line, we do not have to concentrate on one model of a given airplane. I do not mean by this that one ship coming off might be a four-engined Liberator and the next a Vultee trainer. The planes on the line must be of the same general size and design.

As an example, let us again go to the automotive industry. Prior to the war, basic yearly models came off the conveyor line in all sorts of shapes, sizes and colors. There would be a blue seven-passenger sedan, then a green convertible, and then a brown coupe. We may not be able to specialize to this extent in the aviation industry, but it will be possible to run 50 units of one model down the line, and then run 50 of another, and 50 of still another. To accomplish this we would use adjustable jigs and fixtures, the existing stockrooms, and station facilities along the line. We can use the conveyor line to make lots of 50 more economically than we could make them if we went back to the outmoded prewar methods.



Built-in application of Thy-mo-trol to form and thread milling machines.

Electronic Variable Speed Drive

(*Continued from page* 33)

basic, during which it has full-armature voltage and reduced field voltage, the motor will provide constant horsepower and reduced torque output. This is illustrated in the accompanying chart (see page 32) which shows the torque and horsepower curves for the full operating range. It also illustrates how the speed is increased by armature voltage as the speed adjusting potentiometer is turned from zero to midposition, and how the motor operates by field weakening from midposition to the point where the knob is turned to the extreme clockwise position.

One very important consideration with any electronic equipment is the question of what will happen if one or more of the tubes should fail. In this system, the circuits have been so designed that the equipment is entirely safe regardless of which tube or combination of tubes may fail. The equipment will either shut down instantly or will continue to operate, deprived of the function of the tube which fails.

Many interesting applications of the Thy-mo-trol drive have been made—most of them to machine tools because of the present limitations in size. Among the types of machines to which drives have been successfully applied are grinders, milling machines (see illustration), tool-room lathes, turret lathes, and thread mills. In addition, they have been supplied for automatic welding machines, for testing magnetos, airplane propeller governors, and instrument tachometers.

A particularly interesting application has been made for driving the headstock on grinders. The wide speed range obtainable and the constant torque characteristics provided at low speed make it possible to provide the right speed for every type of grind. In several instances the new control has made possible a simplification in the headstock through the elimination of gears and pulleys.

Another important factor in this application is that the equipment can be mounted on the grinder without fear of introducing any undesirable vibration such as might be produced with high-speed rotating apparatus. The machine can be made entirely self-contained, and it can be moved at will without worry as to the availability of a d-c power supply.

For reversing table drives, the use of two independent speed-adjusting potentiometers makes it possible to provide full range, independently adjustable speed for both directions of travel. A simple relay for selection between the potentiometers and a standard double-throw limit switch are all the additional material needed.

The electronic control also can be supplied in a form suitable for building into a machine in the same manner as conventional control equipment. An interesting application on a thread miller is shown in the accompanying photograph. In this instance, the electronic equipment is combined on a single panel with standard magnetic switches used for starting the coolant pumps, etc.

Borg-Warner Making Gun Mounts

(*Continued from page* 13)

of usage along side of the assembly line.

Assembly starts with the big pedestal, the final gun mount being integrated by adding parts and sub-assemblies as the pedestal is moved along the roller conveyor from station to station. During the assembly operation the operators, skilled in their various tasks, make extremely fine adjustments of the various elements. The finished product is essentially a precision-built mechanical jack.

Immediately upon removal from the assembly line, the gun mount is inspected for acceptance by Navy inspectors, checked for operational features and for balance.

It is well to emphasize, in closing, that this gun mount is in reality a rather fussy mechanism, involving a great deal of precision work not ordinarily associated with the machining of some of the heavy pieces found here. Perhaps a better impression of the details of operation can be gained from a visual examination of a sampling of the machine shop set-ups shown in the pictorial section of this article.

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SPECIFICATIONS

WELLS No. 8

Capacity: Rectangle..... 8" x 16"
(spec. bowed guides)... 5" x 24"
Rounds..... 8" dia.
Speeds: ft. per min. 60, 90, 130
Motor..... Specifications optional

WELLS No. 5

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(spec bowed guides)
Rounds..... 5" dia.
Speeds: ft. per min. 60, 90, 130
Motor:.... Specifications optional

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Nitric-Hydrofluoric Bath for Removing Welding Flux

(*Continued from page* 19)

the hot water rinse. The time of immersion in the hot water (temperature 80 C to 95 C) should not exceed three minutes, otherwise staining of the etched surface might result. The material should be dried immediately after being removed from the hot water.

Equipment Required

The cleaning and rinse tanks should be large enough to permit the work being cleaned to be totally submerged, and freely manipulated while submerged, without scraping or bumping the sides of the tank. The tanks should also be equipped with bottom drains in order to facilitate draining and cleaning.

The bath tank and the cold water tank should be constructed of wood, cypress preferred, caulked with an asphalt-base caulking compound and painted inside and outside with four or five coats of phenolic resin or other acid resistant material. These tanks, if constructed properly and used with a reasonable amount of care, will give long, trouble-free service.

The hot water tank should be constructed of aluminum or steel lined with aluminum. If, however, aluminum is not available, wood may be used. In event wood is used, the inside of the tank should not be painted and wooden battens should be substituted for the caulking compound. If steam is to be used for heating the water, the heating coils should be of the closed type and constructed of aluminum tubing. The use of other metals for this purpose may lead to difficulties.

The overflows for the cold and hot water rinse tanks should be large enough and located in such a position as to permit the oil and foreign matter which might float on the surface of the water to drain completely away.

If the nature of the articles being cleaned is such that racks would be required for easy handling, the racks should be constructed of aluminum. Although the acid bath will attack the metal, the rate of attack is so slow that the need for replacement is infrequent. *Wood should not be used in the construction of the racks* since it soaks up a considerable amount of acid which would contaminate the hot water rinse and cause severe staining.

Maintenance of the Bath

To make up a new acid bath, partially fill the tank with clean cold water, add the proper quantities of nitric acid and hydrofluoric acid and then fill to the working level by adding cold water. If the temperature of the water from the regular supply system is substantially lower than room temperature, hot water may be substituted for some of the cold water in order to bring the bath up to room temperature.

The nitric acid and the hydrofluoric acid content of a new bath should be determined by analysis and adjusted, if necessary, to the proper concentration. As the bath is used, frequent determinations of nitric acid, hydrofluoric acid and hydrochloric acid should be made. The nitric acid content will not change to any great degree. However, chlorine and fluorine are both present in the flux and, therefore, the concentration of these elements will vary. The ratio of nitric acid to hydrochloric acid or hydrofluoric acid should be maintained at roughly 40 to 1. When the hydrochloric acid content reaches approximately 3 grams per liter the bath should be discarded.

When handling the acid bath or the acids which are used to make up the bath, caution should be exercised. Rubber gloves and goggles should be worn at all times since these acids, particularly the hydrofluoric acid, will cause painful and dangerous burns. Since there is some fuming from the acid bath, the unit should be located where there is good ventilation, otherwise the tank should be equipped with exhaust ducts.

In order to prevent an accumulation of acid in the rinse tanks, a considerable flow of fresh water into the tanks should be maintained. This will contribute to a cleaner, more uniform appearing product and longer life of the equipment.

Developments in Sheet Metal Fabrication

(*Continued from page* 23)

One of the most significant developments has been the Kirksite shear die for blanking parts on the punch press. Conventional punch press dies are made from high-grade steel and, since both punch and die must match perfectly, considerable skill is required to manufacture a set of dies of this type. Naturally these dies, commonly referred to as Class "A" dies, are expensive and their use is not justified unless either a great many parts are to be blanked or the geometry of the part is such that no other blanking process is satisfactory. It has been for this reason that routers have been predominately used for the blanking of sheet metal parts. The discovery, however, that Kirksite could be sharpened and would retain a shear edge led to the development of the PBT, which is the Douglas Aircraft Company's designation for an extremely economical type of die known as a Pierce-Blank Template. A PBT die set consists of 2 parts, a C.M. or high carbon steel punch and a Kirksite die. The outline of the part to be sheared is laid out on the steel punch either from a layout template or by means of the recently developed photographic layout techniques. The punch is then cut and ground to this outline (see Fig. 4). Holes are drilled in the punch wherever holes are designed in the part. The outline of the punch is then scribed onto a Kirksite plate which is cut undersize and at a bevel.

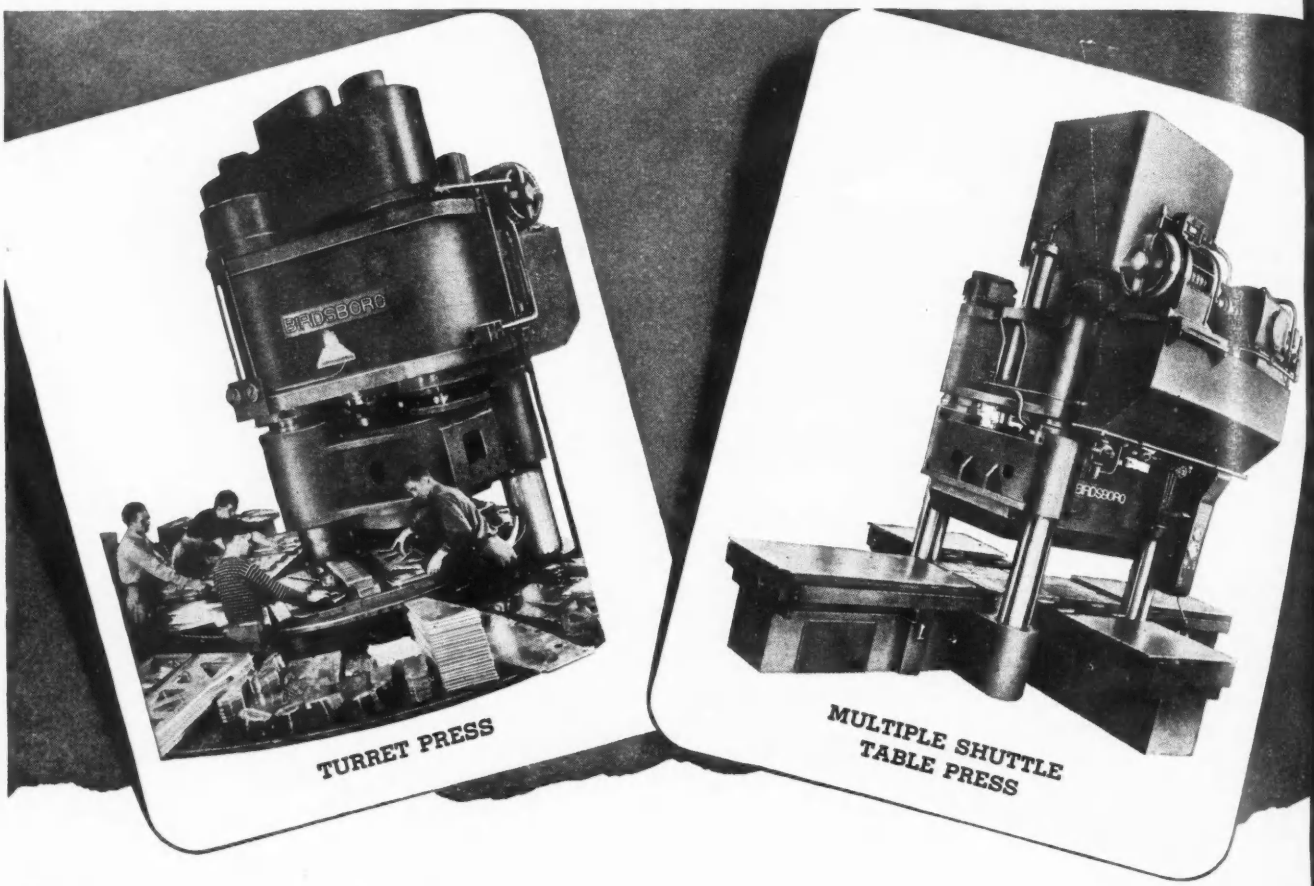
Punch and die then are riveted to separate steel backing plates which are of such a size and shape that they may be mounted in standard die sets. The punch and die complete with backing plates are then mounted in the die sets and brought together in a punch press. The press forces the steel punch down into the Kirksite die, shearing off the overhanging edge. A zero clearance die results. The dies are taken from the press and piercing pins are located in the backing plate of the Kirksite die to match the drilled holes in the punch. Strips of rubber and rubber grommets are then cemented around the punch, piercing pins, and cutting edges of the die. These pieces of rubber help hold the set firmly during the blanking process and also force the scrap and blank from the dies after the shearing has taken place and the dies have separated. A completed PBT is shown in operation in Fig. 4.

These dies are so inexpensive that they have nearly replaced both the routers and the router drills. They have been made successfully as large as 35 by 76 in. and have functioned perfectly for as many as 5000 parts. They are ideal for parts embodying a great many pierced holes and also give higher fidelity of reproduction than can be obtained from the router. In addition, a modification of this type of die has been recently developed so that now both blanking and shallow forming, such as lightening holes and beads, can be performed in a single hit of the die.

Any discussion of improvements introduced in the basic methods of sheet metal fabrication will be in the nature of a progress report. The improvements described above are for the most part experiments that have only recently emerged as actual production techniques. Others which are still in the experimental stage must be reserved for subsequent consideration.

New Cylinder Liner

Thompson Products, Inc., has patented a split cylinder liner which is rolled up from sheet stock over a mandrel, and is then nitrided or hardened Then it is inserted in a fixture of the same bore as the cylinder and is honed. After being honed it is compressed until the gap is closed, and can then be freely inserted into the cylinder, whereupon it will expand against the cylinder wall in the same manner as a piston ring. The liner can be held in position between a shoulder in the cylinder and the cylinder-head gasket.



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